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HURRICANES.

IT is with deep regret that we have to record the passage of yet another hurricane which will be remembered as one of the worst in the history of all those West Indian Islands which were unfortunate enough to experience it. The full story of the disaster will not be known for some time yet, as most of the lines of communication have been cut off, but from some of the accounts already published the damage done to all forms of property seems to have been exceptionally severe. Dominica, Montserrat, St. Kitts and Nevis were amongst the chief British Colonies which experienced the full force of the storm. Guadeloupe, however, was the main centre of destruction and it will be a very long time before this French Colony can recover from the damages which it sustained. In Porto Rico martial law has been proclaimed and a famine has been predicted. The hurricane which continued its course over the Turks Islands eventually reached Florida, where it did extensive damage to citrus plantations, before it finally died down on the borders of Carolina.

The latest reports received tell very much the same stories about the appalling loss of life and of property on the islands concerned. Most buildings and specially the peasants' small wooden huts were severely damaged or completely destroyed. Electric light and telephone services and water supplies were entirely disorganised, while heavy seas battered jetties, roads and even streets. A large number of boats were lost at sea while, in some instances, others were landed high and dry on the beaches.

All forms of agricultural property suffered heavily. The Botanic Gardens of Dominica, Montserrat and Nevis were wrecked and, with them, years of work. The wind flattened out most of the main crops on the principal plantations. Reports from St. Kitts state that their 1929 cane crop sustained a loss of 25 per cent. to 50 per cent. while their cotton lint which was ready for export had been damaged from rain water getting into the storage houses. In Dominica, thousands of economic trees were uprooted, the hurricane coming as the *coup de grâce* to an island which has of recent years been afflicted with floods and serious plant diseases. Estate buildings, cotton ginneries, sugar factories and distilleries were all affected to a lesser or greater degree. Losses of livestock were numerous and most of the mule and cattle sheds were levelled to the ground. The hurricane, in short, left a trail of wreckage and desolation wherever it went. Finally, lack of food and of clothing, of houses

and of water have increased tenfold the discomforts of the unfortunate inhabitants and may lead to further troubles by causing disease epidemics.

It is not surprising, under the circumstances, that frantic appeals for help were made by the victims of the storm. The response to these appeals has, however, been magnificent, and much public-spirited work is now being done to raise money and clothing. Numerous public funds have been opened and, in some cases, relief parties have already been sent out. Money will be particularly needed in view of the fact that the total revenues of the Leeward Islands affected by the disaster are too small to provide adequate help to the victims and will even be strained beyond their means in repairing the damage caused to the roads, telephone and telegraph systems, harbourage and public buildings. It is probable that in none of these islands will there be any State funds available for distress and the call to private benevolence will therefore be all the greater.

West Indian history abounds with stories of hurricanes which have occurred almost every year with varying degrees of violence. They have been particularly prevalent during the months of August, September and October. A distinctive feature is that as the hurricane approaches, the barometer falls, and, as it falls very slightly in the West Indies, this fall constitutes a most valuable warning of approaching danger. Sir Francis Watts gives the following description of a hurricane :

"As the storm approaches the following unmistakable signs display themselves ; the barometer falls rapidly ; halos are seen around the sun and moon ; the ocean swell increases ; the weather becomes hot, moist and oppressive, with light, variable winds ; deep red and violet tints appear at dawn and sunset, tints which assume a coppery glare of ominous aspect ; a heavy mountainous cloudbank on the distant horizon indicates the position of the approaching storm ; the barometer falls more rapidly, and, finally, if the observations are made on or near the storm track, in the West Indies, the wind begins to blow in a direction between the north-east and north-west soon arising to hurricane force, increasing till the control calm passes, then breaking out with violence from the south to south-east." This almost tallies with the description of the recent hurricane given by the Curator of Montserrat who, however, supplements it with figures. He states that the barometer fell from 29.93 to 28.20 and when it reached this point the observer had to seek shelter in another part of the house because the roof had been lifted completely while all doors and windows had been blown open. The wind was then blowing at 120 miles per hour, the worse period of disturbance being reported to be between 6 and 7 p.m. on the 12th September.

The origin of hurricanes has been explained by the hypothesis of low pressure areas and has been briefly outlined as follows :* "When the sun moves from the Tropics of Cancer towards the Equator its rays get more fiery and aggressive because they strike the earth's crust perpendicularly. At the same time there generally is a certain wind calm and the heat waves coming into contact with the overheated soil or the sea surface undergo a great rise in temperature. Further, the heat waves' excandescence makes them lighter and the air ascends to such an extent that in certain zones it rarifies itself very strongly, creating vacuities. The rarer the air, the lighter it becomes, and then a centre of extreme low pressures is formed which all winds from cardinal points that are inclined to fill up the void space created, precipitate themselves, determining now a rapid encircling movement of the aerial currents sometimes in a clockwise and at other times in an anti-clockwise sense."

It is fortunate for British West Indian interests that the services of the United States Weather Bureau is at their disposal. The Bureau which was established in 1898 maintains a number of meteorological stations throughout the West Indies which supply all the necessary data for forecasting hurricanes and which issue, well in advance, storm-warning messages to those immediately in danger. The Bureau " spares neither pains nor expense to protect and save, if possible, life and property without distinction of nationality," and, as such, is doing invaluable work for the British West Indian Colonies situated in the hurricane zones.

It will, of necessity, take much time, labour and money to repair the extensive damage done to agricultural property and, as the chief industries on the hurricane stricken islands are agricultural ones it is essential that effective measures should be taken as soon as possible, to place these industries on a sound footing. This is not the first time that the economic stability of the West Indian Islands concerned has been severely shaken by the destruction of their crops. To avert the repetition of the heavy losses sustained on perennial and fruit crops and to ensure a greater degree of stability it may be desirable, in future, to adopt a policy with a view to extending the acreage under annual crops. In the past, the Imperial Department was mainly responsible for supplying the new planting material, and this work requires extreme care, owing to the numerous dangers that may arise from plant pests and diseases that may be brought in by material from doubtful sources. The Imperial Commissioner is now making a preliminary survey to investigate the needs of the devastated areas. His report should throw much light on the present state of the Agricultural Departments and Botanic Gardens which he will visit, and should help to frame the future policy of the College with regard to the part which it could play in any work of reconstruction.

*_Port-of-Spain Gazette_ 5th October. " Present Cyclone season in Caribbean Sea " by E. Sifontes.

SAN THOMÉ CACAO INDUSTRY.

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Geographical.

SAN THOMÉ is a Portuguese island, lying on the Equator in the South Atlantic Ocean, and situated about 160 miles from the West Coast of Africa. It has an area of 386 square miles, and, although larger than Tobago, is smaller than Trinidad.

The Island of Principé forms part of the colony of San Thomé. Principé is 90 miles north of San Thomé, and has an area of 48 square miles. Both islands, of volcanic origin, grow cacao exclusively, and are connected with Europe by Portuguese steamers which run from Lisbon once or twice a month and take fourteen days for the voyage.

San Thomé is distinctly mountainous, without well defined ranges but with numerous steep hills, with tall "pics," varying from 2,500 to 6,600 feet altitude intersecting the island in all directions, and making the scenery most enchanting. The San Thomé Pic is the highest, and rises to 6,640 feet. The deep and generally narrow valleys are well watered by numerous rivulets mostly perennial.

According to official figures, there were in 1914, 53,969 inhabitants, consisting of 1,401 Europeans, 19,751 natives, and 32,817 indentured agricultural labourers from Portuguese Africa.

Climate.

In general, the climate is like that of Trinidad with the dry season from May to September, the rainy season from October to April, and a short Indian summer in January. The prevailing winds come from the south and south-west. The northern half of the island is dry, and the southern very wet. In the leeward or northern district the rainfall is low; from 1915 to 1920 it varied from 24 to 72 inches per annum. In the south the rainfall is between 75-100 inches. The dry season is very severe in the leeward district, and there have been as many as 160 days without rain. Were it not for the rivers which flow continually in the numerous valleys, this side of San Thomé would be more like a desert than a district in which cacao can grow. The temperature varies from 80°F. at sea level to 60°F. and less on the heights.

Soil.

On the whole, the soil is good, and by constitution, is well suited to cacao. The accumulations of soil in valleys and hollows are well provided with humus. Here and there clay formations are less suitable for cacao cultivation, and, in some districts, soil manipulation is rendered difficult by the presence of accumulations of large boulders in the subsoil.

Products.

Although cacao has been the main crop grown in San Thomé since 1880, sugar was the principal agricultural industry from 1550-1650, while coffee was mostly cultivated from 1720-1880. Cinchona is grown to a small extent at altitudes above 3,000 feet; oil palms are found all over the island, but the oil manufactured is used locally. Coconuts grow well, but little attention is paid to them as a staple product.

Cacao Plantations.

The principal cacao plantations consist of groups of estates called "Roças," generally owned by companies whose headquarters are at Lisbon. One of the largest is the Sociedade Agricola Valleflor, which consists of three groups comprising a total area of 41 square miles. There are also smaller estates owned individually by Europeans and natives, and small-holdings owned by natives.

The large estates or Roças which involve a very large capital, are marvels of organisation. Their headquarters form little towns consisting of residences for the staff, offices, recreation rooms, hospital, school for children, laundries, bakeries, workshops of all kinds, extensive store-rooms for food and estate supplies of all kinds, palm oil factory, rum distillery, saw mills, repair shops, and extensive barracks for the labourers, besides fermentation and drying houses. Most of the estates have a little port of their own connected with headquarters by a narrow gauge railway, tramway or good road. As all produce has to be shipped by each estate, there are jetties and cranes, lighters, boats and motor launches with the necessary slipways and repair shops, besides large sheds for produce.

The self-sufficing family holdings which are owned by peasant proprietors are conglomerations of mixed cultivation, where the growth of cacao, which is itself planted at random, is handicapped by the cultivation of ground provisions and by many kinds of trees, the chief of which are oil palms, mangoes, avocados and other fruit trees.

Roads and Fields.

There are good systems of carefully graded roads that follow the contours of the numerous valleys. Narrow gauge lines are put down on all the main roads, and the trucks are pulled by small locomotives or mules; the roads are so graded that all the full trucks gravitate into the yards.

At Rio de Ouro, there were 124 miles of tramway and seven miles of railway lines. In most places the sides of the roads are planted with pineapples and lemon grass. The cacao fields are not well laid out and difficult to locate.

Cacao cultivated.

The predominating variety cultivated has a yellow pod with a slight constriction at the neck, five to seven inches long, with ten longitudinal grooves, average of 42 beans per pod, purple break. It is called "creoulo" at San Thomé, but it should not be confounded with the Trinidad "criollo" variety. There are also some red varieties of cacao, but they were in a small minority in most of the places visited.

On the whole, the trees compared with those of Trinidad are small in girth; in many places they are overcrowded and show a long thin stem with a small crown of leaves. This condition is

brought about by trimming off all side branches. This system has, however, been stopped. On some recent plantations where the trees had been planted in the West Indian way, the yield was good, but the trees still remained comparatively small. In a well protected locality with good soil, a five-year old cacao tree, only about seven feet high with about three feet of stem, had yielded seventy pods, while another of the same size had fifty-five pods. On the original plantations which were no doubt started by natives, there was no regular distance for planting.

Nursery Practices.

A system of planting cacao at stake or from seedlings adopted by some estates in San Thomé and Principé, consists of putting the seeds or seedlings of the cacao plant into holes about three feet cube, which have been filled with manure, old pods, banana leaves and stems and surface scrapings to within a foot of the top. The idea of this faulty method of planting is to protect the young seedling from the wind.

Seedlings are grown mostly in baskets made of strips from the fronds of oil palms or coconuts. Another ingenious method of making pots for seedlings should be mentioned. The half of a banana leaf is rolled up in such a manner as to form a hollow cylinder about six inches in diameter and is held together by a piece of split wood which is used as a clip ; the bottom is formed by folding in part of the leaf. Pots made in this way last about six months.

Planting Distances.

No particular distance was observed at first, and in many places trees are seen as little as six feet apart. On the large estates, these conditions are gradually being remedied, and trees are now planted at least 12 feet from each other.

Shade and Wind Breaks.

The bad management of shade, and the absence of wind breaks, have been the chief causes of the loss of a great many trees in San Thomé. The original small estates were overshaded by all kinds of unsuitable trees, but, when large estates were established, no special shade trees were planted, but some of the original forest trees were left. These were quite unsuitable, having small crowns of leaves on very tall stems, and many of them possessing extensive root systems which handicap the roots of the cacao trees. In some places, the forests were all felled, and the ridges left bare. There was generally too much deforestation in the regions below 2,000 feet where cacao grows best, and the effects were particularly disastrous in the leeward part of the island. In some parts, efforts have been made to establish wind breaks, but in this respect there is plenty of room for improvement. Young cacao is generally well shaded with bananas, but the old trees are not always protected by the right kind of permanent shade. *Erythrina* trees are very rare. Instead of them, many species of imported fruit trees are used, such as breadfruit, Jack fruit, avocado, hog plum, soursop, cashew, cola. On the sides of the roads, there are avenues of *Castilloa*, *Funtumia* and *Hevea* rubber trees. Oil palms are grown in all fields in the flats, and do not seem to do any harm to the cacao.

Field Practices.

In the past, the fields received very little tillage and drainage. One of the most popular forms of cultivation was as follows : holes of about three feet cube were dug in the dry season, left open during that period and filled up with mulch, cacao pods and surface scrapings. Hardly any systematic drainage was carried out. In the very dry leeward part of the island, it was possible to irrigate in places with the abundant water supply from the hills.

Reaping.

The picking of cacao is carried out by gangs who use cacao knives somewhat similar to the West Indian type. The pods are collected in bags, and the heaps are made near the tram lines, where the pods are broken and loaded into trucks for conveyance to the yard. There are depots all along the line with proper sheds for storing wet cacao until it can be removed. The trucks run directly into a building where the fermenting boxes are situated, or they run above the boxes where the wet cacao is allowed to drop through trap doors. The cacao is sweated as a rule for six days, drying is done in the sun and by means of artificial steam dryers. When utilizing the sun, the cacao is spread in large trays of which there are several tiers. While this system saves space, it is not as easy to protect the drying cacao from sudden rain as with moving roofs. The artificial dryers are more in use in the windward or damp part of the island.

The cacao in the drying trays is moved about by means of long-handled wooden rakes. As soon as the beans are quite dry, they are put into large heaps in very spacious sheds, and are as a rule carefully hand-graded by women. On some estates there are garbling machines. There is no claying of any kind. The great care exercised in the preparation and grading of cacao at San Thomé has resulted in the production of a cacao of excellent quality that always commands a good price. Cacao is shipped in bags of 132 lb. net weight.

Labour.

Labour has always been a difficulty. The natives of the island cannot be relied on, and nearly all the labour has to be obtained from Africa, under a system of indenture. Some years before the War, there were allegations of ill-treatment of labourers at San Thomé, but the charges were not proved. To day the indentured labourers are very well looked after by the government, and are boarded and clothed by the plantations. Each estate has a well equipped hospital managed by a trained European staff ; many large estates have a resident medical officer of their own, and estates with over a thousand labourers have to be visited by a doctor once a day. The labourers work for ten hours a day, and are paid monthly, part of their wages, is

SAN THOMÉ CACAO INDUSTRY.

(Photographs published by the kind permission of the Director of Agriculture, Trinidad.)

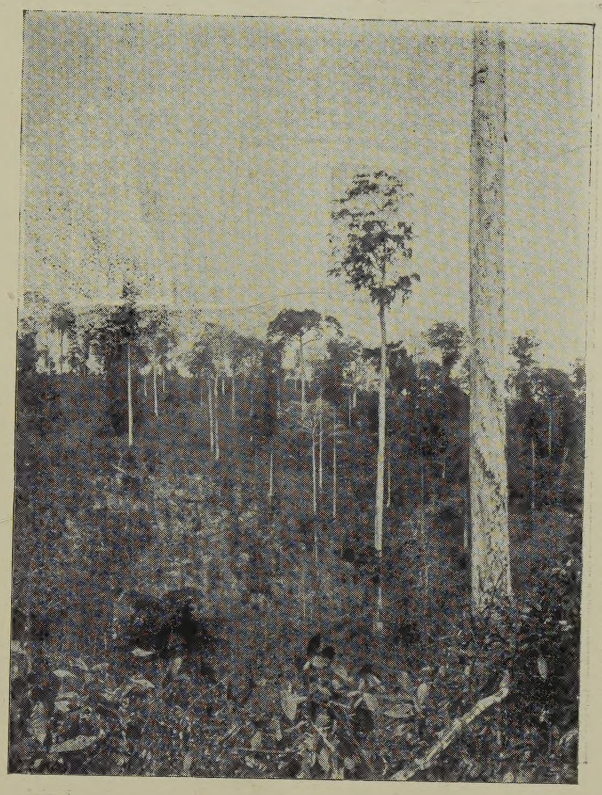

Photo by *F. W. Urich.*

Field showing type of forest trees left for shade.

Photo by *F. W. Urich.*

Trees severely attacked by thrips and algal diseases.

SAN THOMÉ CACAO INDUSTRY.

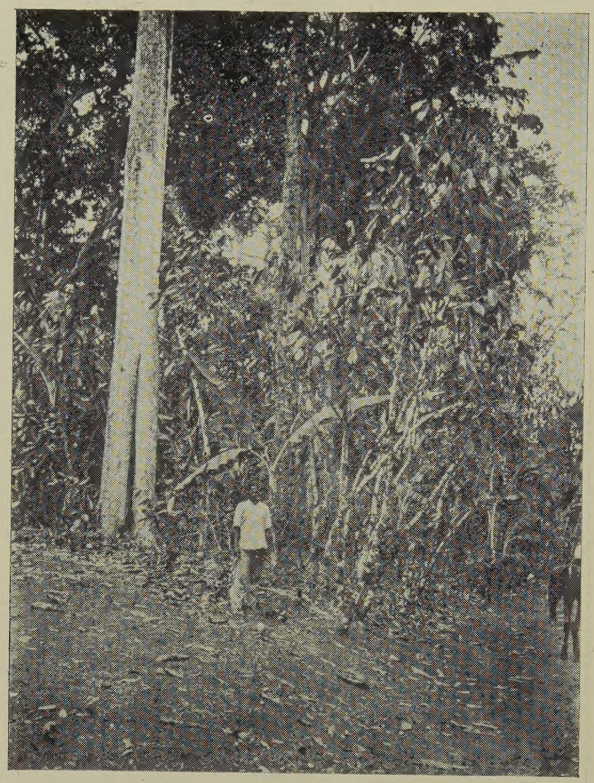

Photo by *F. W. Urich.*

Part of small holding affected by overcrowding, thrips and algal diseases.

Photo by *F .W. Urich.*

Cacao trees destroyed by exposure and thrips.

however, banked for them until their indenture is terminated. The children are taught the three R's at the estate school, and the older ones are trained in the workshops.

Managers and overseers are all European, and on most estates, are boarded free of charge. They spend their holidays in Europe, their travelling expenses being paid by the estate.

Insect Pests.

The cacao thrip, *Selenothrips rubrocinctus*, was the principal insect pest of San Thomé at the time of a visit in September and October, 1920. The planters were inclined to attribute nearly all their losses to this insect, but there were many estates in the leeward district with a high percentage of dead and dying trees, where few thrips were observed. There was much algal disease and die-back brought about by long droughts, faulty cultivation, exhaustion of the soil and exposure to strong winds. In days gone by when there was much trade with Brazil, cacao plants and many species of fruit trees were imported from that country, and, if thrips did not already exist at San Thomé, it is quite possible that they were introduced on some of these plants. Chevalier states that the first cacao plants at San Thomé came from the Island of Fernando Po *via* Principé in 1822. In recent times, there have been many importations of cacao from South American countries besides Brazil. The following host plants of thrips have been recorded from San Thomé: hog plum, guava, avocado, pomme rose, cashew, mango, and almond rose, all of which occur in this part of the world. Several native plants of San Thomé are also attacked. It is not quite certain when thrips first made their presence felt on the cacao plantations, but Navel states that from information gathered from the San Thomé planters, it would appear that in 1910 cacao trees were damaged to the extent of shedding their leaves. In 1917, thrips were positively recognised as serious pests at San Thomé by Cortesoa. In 1918, the yields of estates appeared to decrease, and in 1919 one company lost one-third of its crop. These losses were due, not only to thrips, but also to algal disease, die-back and severe drought. The enormous multiplication of thrips was due to favourable climatic conditions, numerous food plants other than cacao, want of wind breaks and overhead shade, and general debility of the cacao trees brought about by continuous cropping without suitable cultivation. The climax of the thrips attack was reached in the unusually long dry season in 1919, when only 24 inches of rain were recorded in the leeward district. Had all the plantations been situated on the same level, the severe droughts of 1919 and 1920 would have killed out most of the thrips as happens in Trinidad and Grenada, but with the configuration of San Thomé it is different; a great many estates are situated at higher levels than in Trinidad, and so give thrips an opportunity of living in the more favourable damp climates of heights between 1,000 and 2,000 feet. On arrival at San Thomé in September, 1920 (where no rain had fallen since June), there were very few thrips at localities situated below 1,000 feet, but above that altitude there were a great many. With the altitude, the moisture increased gradually, until at 2,000 feet, the thrips decreased. At 2,362 feet, it was damp enough for a parasitic fungus to be quite effective in destroying all stages of thrips as well as other insects. In the rainy season, the reverse takes place. Thrips then gradually descend to lower levels. Cacao on heavy clay soils seems to suffer most.

The abundance of food plants also greatly helps to increase the multiplication of insects on flat lands near the capital of San Thomé, where the soil is not particularly good for cacao cultivation. The ground had been taken possession of by thousands of wild guava trees, on which thrips breed to such an extent that they were all defoliated and killed. Thrips also breed on most of the trees mentioned above, which are scattered about the cacao, sometimes in large numbers. The absence of wind breaks greatly facilitates the dispersal of the winged thrips by wind and by flight. Many an estate was known to have remained comparatively free from thrips as long as it was protected from the wind by forest trees. As soon as the forest trees were felled, the cacao trees were invaded by thrips, and in some instances, they were damaged beyond recovery.

As in Trinidad, male thrips were always present in cases of severe infestation. Larvae of *Chrysopa* were found preying on all stages of thrips, but were not numerous enough to do much good. A species of *Triphleps* was also observed to be *predaceous* on thrips, but it was not common. The entomogenous fungus referred to above was quite useful in damp districts.

Leaf-eating Insects.

No leaf-eating beetles were observed, and the leaves did not show the numerous perforations one is accustomed to see in Trinidad, caused by *Chrysomelid* beetles. The sole representation of this family of beetles, according to Navel, is *Nisotratheobromae*, Labois, which attacks pods and eats furrows on their surface. As in every cacao growing country, the young leaves of the full grown trees are attacked by several species of indigenous caterpillars, none of which were numerous enough to be classed as pests. The young leaves of nursery plants were often attacked by cut worms in the same way as they are in Trinidad. *Borers* in stem or cambium, consisting of larvae of different orders of insects, were not numerous. There were none as bad as the cacao beetle, and of the only two that were observed, one was the caterpillar of the moth *Eulophonotus my. meleon* and the other a beetle, *Apate monachus*; the first named was more injurious *but neither were numerous.*

Scale Insects and Mealy Bugs.

The scale insect, *Aspidiotus trilobetiformis*, is fairly common in cacao estates, but it is kept in check by parasitic fungi. The mealy bug,

Pseudococcus citri, was not absent from San Thomé, but was well kept in check by natural enemies. The aphid, *Toxoptera coffae thomensis*, was fairly common on young leaves, but did little damage, as it was kept in check by natural enemies, syrphid flies and coccinellid beetles particularly.

Membracids, Jassids and Fulgorids, which are numerous on West Indian and South American cacao estates, were absent or rare at San Thomé.

A species of *Helopeltis* was observed in the higher altitudes in very damp places. It attacked fruit and young twigs. In the districts visited, it was not very numerous. The principal damage is done to young pods that are destroyed when the feeding punctures of the insects are numerous.

Ants.

There were few ants in the cacao, and some cosmopolitan species were observed near the buildings. Leaf cutting ants (*Atta*), and Balata ants (*Azteca*), were absent.

Termites.

In the cacao fields of some districts, there were nests of a species of *Termes*, consisting of large mounds of earth which contained the brood chambers and galleries. This particular species did not seem to interfere with the cacao, and cultivated a special species of fungus on which it fed, something like the parasol ants. There were aerial nests of other species similar to those in Trinidad to be observed on the cacao trees, but they seemed to confine their attacks to dead or dying wood.

Of the beetles found in the fields, most of them were scavengers living in their early stages in rotten wood and on the wild plants growing about the fields. There were no beetles similar in habits to our cacao beetles, a feature the San Thomé planters should be very thankful for, as the climate is well suited for them.

Of the Mammals, monkeys and rats are troublesome.

On the whole, San Thomé cacao does not suffer from as many insect pests as in Trinidad, and, were it not for thrips, planters would not have much cause for complaint. Algal disease is very prevalent, and there is also pod rot and canker (*Phytophthora*) in the wet districts; in some parts of the island there is quite a large percentage of loss from a root disease caused by *Rosellinia* sp. Bird vine (*Loranthus*), does seem to exist at San Thomé.

The writer is under great obligations to the Marquis of Valleflor for the privilege of visiting San Thomé, and to Mr. Guilherme Pereira, General Manager of the Sociedade Agricola Valleflor at San Thomé, for his unfailing help during his stay on the plantation.

Summary of principal Cacao Pests.

With the exception of Thrips there are few serious cacao pests in San Thomé.

The determination of the insects was made at the Imperial Bureau of Entomology and the writer is under great obligation to Dr. Guy A. K. Marshall for his help.

The following list contains some of the species observed during the visit to the island. It is necessarily incomplete as some of the parts of the island were not visited. Records by Navel and Seabra have been added.

I. Lepidoptera.

Prodenia litura F. (*Fam. Noctuidae*).

Caterpillars of this moth attack young leaves and also can be particularly injurious to seedling beds.

Duponchelia forealis, Zell. Caterpillars found on young leaves. Not common.

Anomis endochlora. Hmps.

Cerynea trichobasis. Hmps.

Eulophonotus myrmeleon, Feld.

One of the "*borers*," the caterpillars of which tunnel in stem and large branches of trees, causing leaves to wither, and killing branches. Rare in district visited.

II. Coleoptera.

Mallodon downesi, Hope. Scavenger beetle larvae of which found breeding in dead cacao trees.

Apate monachus, L. Boring beetle which tunnels stems of trees, but does not seem to affect them much.

Lymidus variicolor, Berlez. Recorded by Seabra and Navel as attacking young leaves.

Nisotra theobromae, Laboissiere. Recorded by Navel as attacking young and matured pods by eating short furrows on surface. Not common.

Araecerus fasciculatus. This cosmopolitan pest was found in the field on pods killed by *Phytophthora*.

Chlorida festiva, L. Occurs in dry branches. Probably introduced from South America.

Xylionulus transvena, Lesne. Found in trunks of trees killed by root disease.

III. Thysanoptera.

Selenothrips rubrocinctus, Giard. By far worst cacao pest on island.

IV. Hemiptera.

Helopeltis sp. *near sanguineus*. Not common in districts visited. Frequents damp localities where it does most damage. Navel states that it is inclined to increase.

Toxoptera coffeeae. Nietr. Aphis found in small numbers on young leaves. Generally controlled by natural enemies such as species of Coccinellids and Syrphid flies.

Pseudaonidia trilobitiformis, Green. Common in fields, but never causing much damage.

Dactylopius citri. Widely distributed on pods and young shoots but controlled by natural enemies.

Psylla sp. Recorded by Seabra as damaging young leaves and small pods.

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PAN BOILING.

Its Scientific Control and the Zeiss Industrial Refractometer.

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IN 1925 Löwe (1) published a description of a new refractometer which can be built into the wall of a vacuum pan and enables observations to be made of the concentrations of the material in the pan. Kucharenko, Kartashov and Savinov (2) have applied this instrument successfully to the boiling of refinery massecuite at the Kiev sugar experiment station. During the past crop season, one of these new refractometers was installed in one of the vacuum pans at Sandy Lane Factory, Barbados, in order that the application of this refractometer to the boiling of sugar-cane juice might be studied.

In the sugar-cane world the control of the boiling process rests with men whose past experience enables them to exercise a control of the syrup concentrations in the pan by means of sight and touch. Such empirical control demands skilled labour and is difficult to supervise. In order to institute any scientific control of pan boiling it is essential to have some means of following the concentrations of the mother liquor in the pan. For beet juices Claasen (3) has worked out data from which the concentration of the mother liquor in the pan can be estimated from observations of the vacuum and the temperature of the boiling massecuite. Thieme(4) has recently worked out similar data for application to cane juices. Such control methods depend largely on the accuracy with which the temperature and vacuum can be determined and my experience has been that an accurate indication of the temperature of the boiling massecuite is difficult to obtain. The Zeiss Industrial Refractometer is the first instrument which permits a direct reading of the concentration of the mother liquor as it exists in the pan.

Before this refractometer can be applied to practice, it is necessary to determine how a knowledge of the concentration of the mother liquor can be used to control the boiling process. The principles which underlie the scientific control of pan boiling must therefore be considered.

The Theoretical Consideration of Pan Boiling.

The whole basis of the theoretical treatment of the crystallization of sucrose from aqueous solution rests on the solubility relationships of sucrose in water. The solubility of sucrose in pure water has been determined by a number of investigators and we have an exact knowledge of the amount of sucrose which water will dissolve at any given temperature.

Sucrose will also form supersaturated solutions in water. If such solutions are sufficiently supersaturated, they will deposit crystals of sucrose spontaneously. Such highly supersaturated solutions can be formed by evaporating water from a saturated solution or by suddenly lowering the temperature under which a saturated solution is boiling by raising the vacuum. Both methods are used by pan boilers in grain formation. If crystals of sucrose are already present, sucrose will deposit from supersaturated solutions until the point of ordinary saturation is reached.

The state of supersaturation of a sucrose solution is defined by expressing the ratio of the solubility of sucrose in the supersaturated solution to the solubility of sucrose in a saturated solution at the same temperature. For example, at 60°C. the normal solubility of sucrose in water is 287. A supersaturated solution at 60°C. containing 316 parts of sucrose per 100 parts of water would have a coefficient of supersaturation of $\frac{316}{287} = 1.1$

The whole art of pan boiling depends on the control of the supersaturation of the sucrose in solution. When sufficient crystals are present the supersaturation must never be raised to the point where spontaneous crystallization takes place, and yet the supersaturation must be kept sufficiently high to allow sucrose to deposit rapidly on the existing crystal surfaces. Claasen who was the first to establish a definite theoretical conception of the boiling process, considered that the co-efficient of supersaturation should be maintained at 1.05-1.20 whilst molasses or syrup was drawn into the pan and finally raised to 1.25-1.30 before striking.

With a pure sucrose solution it is a simple matter to work out the correct concentration at which to maintain these supersaturations. With cane and beet juices, however, complications are introduced owing to the fact that other substances besides sucrose are in solution and these impurities affect the solubility of the sucrose. Claasen determined the effect of the impurities in beet juices on the solubility of sucrose. He expressed the ratio of the solubility of sucrose in the beet juice to the solubility of sucrose in water at the same temperature in terms of saturation co-efficients. From a knowledge of the saturation co-efficient at any given purity it is thus possible to define the solubility of sucrose in a beet juice of that purity. It is only in the last few years that saturation co-efficients have been worked out for cane juices. Thieme (4) in Java has recently published this work in a paper which is the most exhaustive scientific treatise on the boiling of sugar-cane juices that has yet been published.

Fig. 1, which has been taken from Thieme's paper shows the marked difference between the saturation co-efficients for beet and cane juices at varying purities. It will be seen from these curves that the solubility of sucrose in cane

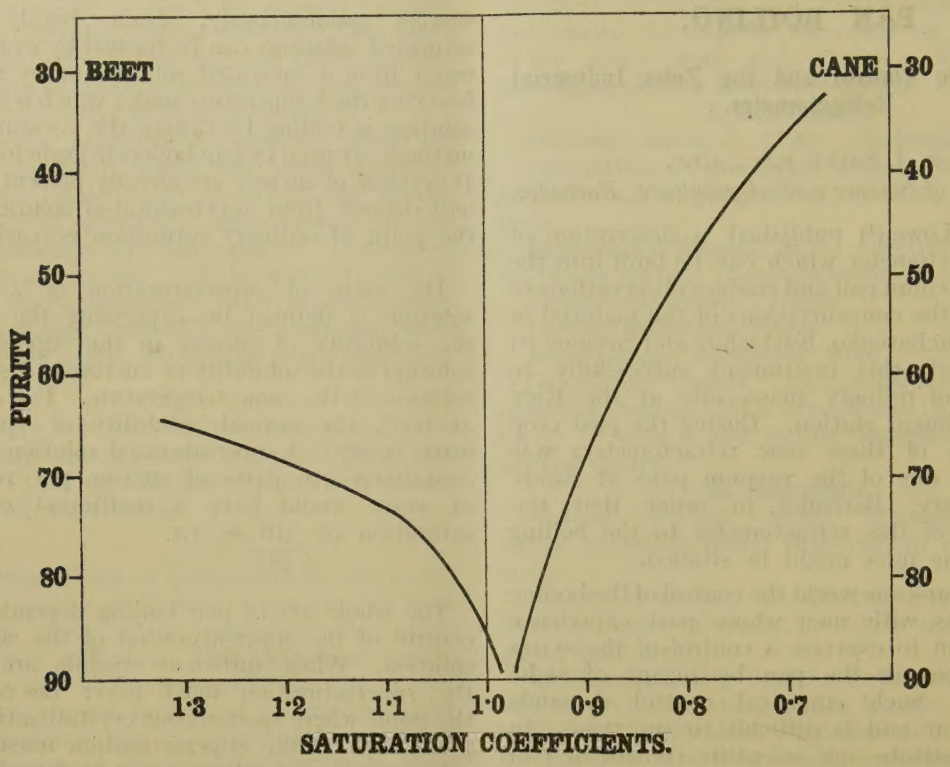

FIG. 1.—SATURATION COEFFICIENTS FOR CANE AND BEET JUICES.

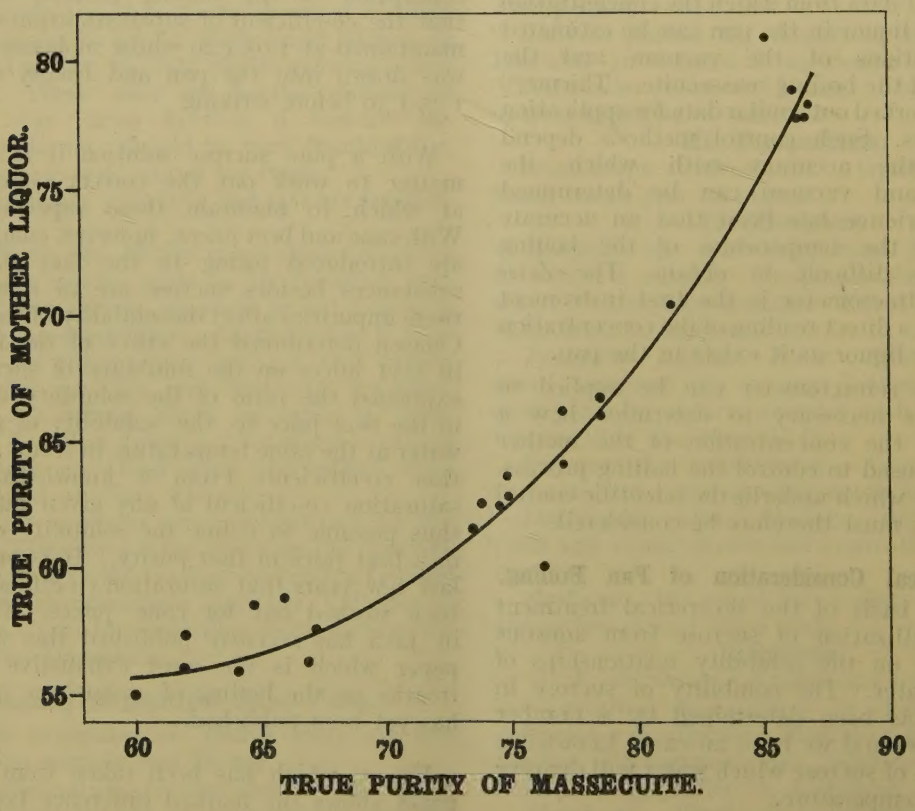

FIG. 2.—RELATIONSHIP BETWEEN PURITY OF MASSECUITE AND MOTHER LIQUOR.

juice is less than it is in water, whilst it is greater in beet juice than it is in water. It is no wonder, therefore, that the application of Claasen's data to cane juices has always been a failure.

In order to define the coefficient of supersaturation of a solution of sucrose in water, it is only necessary to know the concentration, the temperature and the solubility of sucrose at that temperature. With a juice, however, it is necessary to know, in addition, the purity of the juice and the saturation coefficient corresponding to that purity. An equation connecting concentration, coefficient of supersaturation, temperature, purity and the saturation coefficient at that purity can readily be constructed. Any one of these variables can therefore be calculated if the remainder are known. Claasen was the first to equate these variables and his formula is :

$$W = \frac{100\ R}{C_1\ C_2\ Lt + R}$$

where R = purity, C_1 = saturation coefficient, at purity R, C_2 = coefficient of supersaturation, W = water content, Lt = solubility of sucrose in water at t°C. The determination of these variables will be considered in more detail.

1.—*The purity.* Since chemical control is an established practice at all factories, the purity of the strikes boiled in the pan are always predetermined and as one system of boiling is invariably adopted at any one factory, it is not difficult to find the purity of the massecuite at any given level in the pan for each particular strike. At Sandy Lane Factory the 3-strike system (Geerligs "Absolute Recovery" process) is adopted and the purities at different levels in the pan for the A, B and C strikes were determined. From the purity of the syrup and of the molasses which is to be boiled, points can be calculated from which a curve can be drawn giving the purities at all levels.

For the control of the boiling process, however, it is necessary to know the purity of the mother liquor in the pan and not the purity of the massecuite. It was therefore necessary to determine the relationship which exists between the purity of the mother liquor and the purity of the massecuite under the conditions of ordinary pan boiling. The samples of mother liquor were obtained for analysis by filtering the hot massecuite rapidly through muslin on a buchner funnel. These data can be expressed in the form of a curve (Fig. 2) and from this curve the purity of the mother liquor can be obtained if the purity of the massecuite is known. In the above equation — R — the purity of the mother liquor can now be determined and from Thieme's data — C_1 — the saturation coefficient at this purity can be found.

2—*The temperature.*—This, of course, can be obtained with the aid of a thermometer. Knowing the temperature, we can find the solubility of sugar in water at this temperature from a table of solubilities.

3.—*The Coefficient of Supersaturation.* Claasen considered that the coefficient of supersaturation should be kept between 1.05 and 1.20 during the drawing in period and should be raised to 1.30 before striking. Thieme considers that the most practical coefficient of supersaturation to maintain is 1.2 and that this degree of supersaturation should not be exceeded even during the boiling off process. The coefficients of supersaturation which appeared to be the optimum at Sandy Lane Factory during the drawing in period were about 1.15 for A strikes and about 1.2 for B and C strikes. Before striking, the B and C strikes were concentrated until the coefficient of supersaturation reached 1.35-1.40. With a syrup of true purity 84.5-85.0 graining which was performed by the waiting method, took place at a coefficient of supersaturation of about 1.35.

4.—*The concentration.* The determination of the concentration of the mother liquor has always presented difficulties. Claasen found the concentration of the mother liquor by means of the brasmoscope. With the introduction of the Industrial Refractometer an accurate and rapid means is available for the determination of the concentration. This refractometer has been graduated in percentages of dry matter so that when the refractometer is installed in the pan, the concentration of the mother liquor can be read directly.

The Practical Application to Pan Boiling.

It is essential that the practical application of the theoretical considerations which have been outlined should be made as simple as possible. It is therefore desirable to reduce the number of variables which have to be considered in judging the coefficient of supersaturation to a minimum.

Let Claasen's equation

$$W = \frac{100\ R}{C_1\ C_2\ Lt + R}$$

be once again considered.

1.—*Purity.* It has already been indicated how, for any particular type of strike, the purity of the mother liquor at any given level in the pan can be determined. In calculating tables for use with the refractometer it will be necessary to know the purity of mother liquor at given levels in the pan and also the saturation coefficients at those purities. In *using* such tables, however, the purity of the mother liquor and the saturation coefficient can be eliminated and only the level of the massecuite in the pan need be considered.

2.—*Coefficient of Supersaturation.* The experience gained with the aid of the refractometer indicated that the coefficient of supersaturation should be about 1.15 for syrup strikes (A strikes) and about 1.2 for strikes of mixtures of syrup and molasses during the drawing in period. During

the boiling off process the coefficient of supersaturation for the lower purity strikes can be raised to 1.35-1.4 before striking. These coefficients were used in calculating tables for application to practice.

3.—*The Concentration, Temperature and Vacuum.* Having defined three of the variables R, C_1, and C_2—it only remains to give values to the temperature in order that the concentration may be determined. During any one strike, the temperature may vary over a range of 10°C. and if the concentration is to be expressed at temperatures varying by 1°C. a table having 10 columns would be needed for each strike. On the other hand, the vacuum, at most factories, varies very little and as concentration, temperature and vacuum are connected variables, the concentration at any particular vacuum can be calculated with the aid of the data obtained by Thieme for the elevation of the boiling points of cane juices. Hence vacuum may be substituted for temperature in order to introduce additional simplification. In this way tables were constructed for A, B and C strikes which proved very simple to use in practice. Table I represents the actual Table which was successfully used at Sandy Lane Factory for C strikes and which covers the range of purities for this type of strike and the ranges of vacuum prevailing in the pan.

Table I.

Level of Massecuite in Pan.	Vacuum.		
	24 ins.	24½ ins.	25 ins.
20	82.0	81.7	81.4
40	85.2	84.8	84.2
60	85.9	85.5	85.1
80	86.2	85.8	85.5
100	86.5	86.2	85.9
Strike at	88.0	87.7	87.4

In using such a table it is only necessary to observe (*a*) the level of the massecuite in the pan and (*b*) the vacuum. The correct concentration for the mother liquor in the pan can then be read off from the table. If the concentration as shown by the refractometer is too high then the inlet valve must be opened more, whilst if the concentration is too low the valve must be closed until the correct concentration is registered. It was found an easy matter to teach the pan boiler to use the refractometer in conjunction with such a table and this method of boiling was preferred to the more laborious method of taking proof stick samples.

The Brasmoscope Method of Control.

In the brasmoscope method of control the concentration of the mother liquor is determined from observations of the vacuum and temperature prevailing in the pan. These observations enable the elevation of the boiling point of the mother liquor to be calculated and from the elevation of the boiling point the concentration can be found from the data of Claasen (for beet juices) or Thieme (for cane juices).

During this investigation, the necessary data for brasmoscope control were also recorded and one attempt was made to boil a C strike with the aid of the brasmoscope. The attempt was not successful as the brasmoscope indicated a lower supersaturation than actually existed in the pan with the result that false grain appeared.

In order to determine the temperature of the mother liquor three thermometers were placed in the pan at different levels. Usually, the thermometers did not show similar readings so that it was only possible to estimate the temperature of the boiling mother liquor.

In order to record the vacuum, some barometer tubing was fitted up, vertically, in such a way that one end was connected by pressure tubing to the pan and the other end immersed in mercury. A scale, previously graduated, at the back of the tube enabled the vacuum to be determined with accuracy.

Some typical data obtained for A, B and C strikes are recorded in Table II. The calculated temperature has been determined from the vacuum, the refractometric dry matter and Thieme's data for the elevation of the boiling points of cane juices. It will be noticed that in almost every case the recorded temperature is less than the calculated temperature which is contrary to what might be expected. It is hoped to investigate this matter more fully with more accurate methods for determining temperatures during next crop season. The results of this investigation show that the brasmoscope tends to give low indications of the supersaturation especially with the C type of strike. It should be noted that an error of 1°C. in determining the temperature of the mother liquor or an error of 0.5cm. in determining the vacuum makes a considerable difference in estimating the concentration and the coefficient of supersaturation. It is therefore imperative in any system of brasmoscope control that both temperature and vacuum be determined with the greatest possible accuracy. On the other hand, errors in determining the temperature or vacuum of the magnitude mentioned, have little effect on the coefficient of supersaturation as determined with the pan refractometer. The refractometer can therefore be made to give results of considerable accuracy even in unskilled hands.

TABLE II.

No.	Type of Strike.	Temperature. t°C.	Temperature. (Calculated) t°C.	Vacuum cms.	Refractometric dry matter.	Brasmoscope dry matter.	Coefficient of Supersaturation.		
							Refrac. D. M. and Temp.	Refrac. D.M. and Vacuum.	Brasmoscope.
9	A	68.9	69.61	62.25	81.0	80.1	1.161	1.151	1.096
9	A	68.9	68.95	62.9	81.1	81.1	1.116	1.116	1.116
8	B	69.0	71.86	62.9	83.5	79.8	1.182	1.143	0.923
8	B	70.0	69.85	64.1	83.4	83.6	1.141	1.143	1.157
8	B	69.0	69.55	64.8	84.3	83.8	1.221	1.213	1.176
8	B	73.3	72.03	63.5	84.6	85.7	1.172	1.188	1.278
10	C	72.0	75.7	61.6	85.3	81.0	1.278	1.226	0.939
10	C	72.2	75.9	62.25	85.7	82.0	1.262	1.212	0.959
10	C	73.9	76.1	62.25	85.8	83.8	1.218	1.187	1.043
10	C	73.9	77.3	62.25	86.6	83.6	1.291	1.240	1.018

Summary.

The theoretical considerations upon which any scientific control of pan boiling must be based have been outlined. It has been shown from these theoretical considerations how the Zeiss Industrial Refractometer can be applied to the boiling of cane juices.

It has also been shown that the control of pan boiling with the aid of the Brasmoscope is more difficult and yields less accurate results than Refractometer control.

Acknowledgments.

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(3) Claasen. Vereins-Zeitschrift (1901) p. 138.

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BRITISH SUGAR INDUSTRY.

ACCORDING to *Agricultural Statistics for 1927*, just issued by the Ministry of Agriculture, the returns of acreage under sugar beet as at 4th June, 1927, show that no less than 222,566 acres were under this crop, as compared with 125,814 in 1926, an increase of 96,752 acres, or 76.9 per cent. The largest area was in East Anglia and the East Midlands where eleven factories are operating, including two new factories built in 1927. The total production of sugar is estimated at 3,700,000 cwts., and the production of white sugar per acre of beet under cultivation at 1,862 lb.

Despite the important increase in the acreage under sugar beet, the yields were disappointing as compared with 1926, and, as a result, many of the factories suffered from a serious shortage of raw material.

The average yield of washed and topped beet delivered to the factories, which was estimated by the factories at the beginning of November to be 8.1 tons to the acre, did not exceed 6.5 tons. This compares most unfavourably with 8.6 tons to the acre in 1926 and 7.8 tons in 1925. The low yield per acre in 1927 was easily the worst so far experienced by the beet sugar industry in this country, and was undoubtedly due to the bad weather conditions experienced during the whole of the growing season.

As far as can at present be ascertained, the average sugar content for the whole country was about 16.13 per cent., compared with 17.33 per cent. in 1926, and the average purity (percentage of sucrose to dry matter in the beet) was about 87 per cent. This lower purity resulted in the production of molasses being somewhat above the average.

The 1927-28 season has been the worst on record, yet many of the factories report that the general level of beet cultivation showed an improvement over previous years. This improvement may be expected to continue, and, given normal weather conditions, to be reflected in future results.

ST. LUCIA'S BANANA INDUSTRY.

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(*Concluded.*)

Root conditions.

It is an interesting fact that the majority of the banana stools examined showed only a superficial root system.

Under soil conditions No. (I) the rhizomes were fairly deeply embedded in the soil, and possessed a few strong feeding and anchorage roots, most of these being in good condition.

Under soil conditions No. (II) the rhizome was less deeply embedded and root penetration in the clay was remarkably poor. The feeding roots were scanty, and blackened for most of their length, and the absorbing rootlets appeared to die back at frequent intervals, whilst main roots had a water-soaked appearance.

In view of these defects it is a remarkable commentary on the vigour of the banana plant that bananas under these conditions gave much better returns than under soil conditions No. (I). but it is doubtful whether plants could long survive such root reduction without serious loss of vigour and depreciation of bunches.

In utilising such primitive soil it should be a first charge that cultivation should be maintained and the physical conditions of the soil improved, as the small amount of available land restricts the grower to a limited area. This is in contrast to the methods employed in Central America where large areas of land are available ; in such conditions bananas are planted in holes opened through the cutlassed bush, and after taking the first few crops, these areas are abandoned for new ones planted on a similar method. (3).

Disease effects.

Plants infected with Panama disease were in close contact with apparently healthy plants which after a period of two years still exist and continue to fruit, although neglected, and it is interesting to note that recent observations show that many stools in close proximity to earlier sites of disease exhibit no symptoms of disease, and this after the wettest season for 10 years (June to November, 1927) followed by a short but severe drought (January to February, 1928). Such weather conditions are entirely in favour of a rapid extension of Panama disease.

It was also noticed that Panama disease appeared quite frequently as scattered cases, and not often as an extension from a central point (5). Further it should be mentioned that the external symptons of Panama Disease showed certain differences from the published accounts.

A point which needs emphasising was the condition of the water-soaked lateral roots, where these had died back after penetrating a short distance into the soil. This condition was not confined to diseased plants.

Extension of areas, roads and transport.

A considerable impetus was given to banana cultivation as an estate crop, by the information given out by the Banana Company to the effect that banana contracts would be made with estate holders for a specified term to provide for the supply of Gros Michel of seven, eight and nine-hand bunches at stated periods. As a matter of fact this form of contract was not regarded with favour by most planters, since the contract bound the planter to a five-year period during which time he should deliver his fruit only to the Swift Company. None of the contracts were therefore taken up and bananas were later collected by cash purchase at prearranged depots.

Bananas were established in several adjoining areas in the Cul-de-Sac and Roseau valleys, in all about 50 acres, which were being developed by local sugar interests. Development in other parts of the Colony was mainly evidenced by gradual extensions of the Gros Michel stools already present, particularly by small planters. An estate of 700 acres had been acquired by the Banana Company and was being rapidly converted from cacao to banana cultivation ; and by purchase of other land adjoining this property and the original cultivation, the whole area became linked up to form a continuous estate which was all to be planted up in bananas, mainly Gros Michel.

A system of roads was driven through this area to allow of motor transport, horse and donkey transport and as highways for labourers. One ton Graham trucks were subsequently imported for the transport of bananas, the loading capacity being 100 bunches per trip. Meanwhile, the Agricultural Department continued to act in an advisory capacity, special stress being laid on the need for soil conservation. This included the provision of cover crops such as *Canavalia ensiformis*, the retention of belts of the existing forest to act as windbreaks, the extension of the drainage system by contour methods, and suggestions for pruning. With regard to pruning it was found that the average stool should consist of a fruiting stem about 11 to 13 months old—a large sucker about nine months old, to form the next bunch—and a medium sucker of three months, with two buds as followers.

This was the general character of work carried out through all the banana cultivations, in addition to the form of police-work entailed by the inspection service.

The position of Panama disease at the time of the fruit shipments.

Panama disease had in the meantime rendered the original nursery of the Banana Company unprofitable and this area was accordingly abandoned ; planting continued vigorously in the new area consisting of a block of 5,000 acres of forest. These new forest lands gave very good bunches and continue to bear bananas to the present day. The cacao estate already mentioned gave very good returns during the first crop, but succumbed rapidly to Panama disease during

the second year of planting, and it became evident that the soil was thoroughly infected with the fungus, which had no doubt persisted from scattered clumps of Gros Michel used as a secondary crop in cacao.

Some of the affected areas were being replanted with Short Fig, Bout Rond, and the Apple banana (Fig Pomme) a variety somewhat similar to the Bout Rond but with a hard centre. This variety rapidly died out from Panama disease, and little use was made of the other varieties for shipping purposes.

At the time of the regular fruit shipments, the total area under the control of the Company was about 6,000 acres of which about 1,800 acres had been planted up and 250 acres had been thrown out of cultivation through the ravages of Panama disease.

The collection, transport and shipment of fruit.

The first shipment of fruit was made in 1925 to New York and was in the nature of a trial shipment, space being allotted for banana storage in ventilated holds. About 15,000 bunches of various grades were shipped from St. Lucia during this year in excess production over the normal export trade. Owing to the absence of regular fruit boats during this and the following year, much of the fruit was shipped by sloop to Barbados where a somewhat fluctuating market existed.

Definite shipping arrangements were made towards the end of 1926 and a chartered steamship, the *Kong Inge* made her first shipment in November of that year, a crop of 4,673 bunches being loaded for New York where it passed into the hands of a prominent fruit company. The fruit was collected from the lands of the Banana Company, and from the various depots established throughout the island, where planters disposed of their fruit at the rate of *2s. 6d.* per nine-hand bunch. This entailed a considerable amount of organisation, since time, and the condition of the fruit on delivery, was of major importance.

In all, four shipments of fruit were made by the *Kong Inge* during the next two months, a total of 24,422 bunches being exported. Then followed the unfortunate collapse of the industry due to the promoting Company becoming insolvent.

The total crop of the island at this time was officially estimated to be from 10,500 to 12,500 bunches per month, and this output could have been maintained from March to September of 1927, provided the cultivations continued to receive attention, this failing, the output fell off rapidly and much of the fruit was left to rot owing to the absence of shipping facilities.

Shipping problems and market reports.

Bananas as shipped on the *Kong Inge* were stored in open holds but protected from the weather, the bunches being placed on end and kept in position by wooden gratings forming a series of sections through the holds.

The atmospheric conditions in the holds varied over a rather wide range as regards humidity, but temperature was fairly constant, as shown in the following details obtained by the recording instruments of the Department.—(*Ann. Rept.* 1926.)

(1) *Range of temperature and humidity in the Banana holds during the first trip of the s.s. "Kong Inge." 10th November,* 1926 *to 17th November,* 1926.

	Forehold.		After-hold.	
Date.	*Time.*	*Temperature. °F.*	*Relative humidity. m.b.*	*Max. temperature. °F.*
Nov. 10	6 p.m.	75	70 (1)	— (1)
	12 p.m.	77	59	81
11	12 a.m.	78	59	80
	12 p.m.	78	63	78
12	12 a.m.	79	64	78
	12 p.m.	77	56	77
13	12 a.m.	76	59	76
	12 p.m.	75	62	74
14	12 a.m.	74	55	71
	12 p.m.	72	54	73
15	12 a.m.	72	52	71
	12 p.m.	70	50	72
16	12 a.m.	76	40	70
	12 p.m.	55	— (2)	55
	—	—	—	54 (3)

(2) *Conditions of shipments of Bananas,* 1916-1927.

St. Lucia.	*New York.*	*Temperatures in Holds. °F*		*No. of bunches.*	*Condition on arrival.*
		Max.	*Min.*		
10/11/26	17/11/26	80	40	4,673	Moderately ripe.
1/12/26	7/12/26	82	61	6,494	Not ripe.
22/12/26	29/12/26	79	54	7,349	Full ripe.
12/ 1/27	19/ 1/27	77	60	5,906	Moderately ripe.

Under the conditions obtaining in these holds during a voyage of seven days, the fruit was not found to deteriorate unless bruised or over-ripe when shipped.

A shipment of fruit was subsequently made by a local Company formed to dispose of the marketable crop left on the lands of the Banana Company. In this instance the fruit was loaded into closed holds, supplied with forced ventilation by means of fans, after the manner of the modern cargo boat. Following a voyage of about 10 days, the fruit was discharged at New York in a more or less rotten condition. This was a case of decay being accelerated by long confinement in closed holds, from which the carbon di-oxide and the water vapour given off by the fruit, had not been adequately withdrawn.

(1) Loading, open holds and heavy rain falling, departure at 7 p.m. with closed holds.
(2) Holds opened on entering New York harbour.
(3) Final reading with open holds and snow falling.

This venture therefore met with no success and was discontinued. Trials of the Bout Rond banana already mentioned had been made previously in conjunction with Gros Michel shipments but had met with no success, as this variety did not travel well owing to the naturally loose formation of the bunch, and to stem and finger rot to which the Bout Rond is susceptible.

Termination of banana activities and the present state of the plantations.

At the time of withdrawing the employed labour of the Banana Company, a considerable area of the cultivation contained untreated plants suffering from Panama disease. The Agricultural Department was therefore required to carry out the destruction of these plants in order to reduce the amount of infective material and to prevent the leakage of diseased plants from the abandoned estates.

There remained a large number of Gros Michel free from disease and bearing a crop, and the proceeds obtained from the sale of these bunches to local markets were utilised to defray the expenses of the sanitation work.

On the total withdrawal of supervision, and the non-treatment of new cases of infection arising from remaining stools, the position has markedly changed for the worse, and the writer's conclusion is that no further cultivation of Gros Michel on any but a transitory scale would be possible in St. Lucia under the present methods of large scale cultivation, which consist of nothing more than the attempted evasion of the disease by reducing sources of infection, rather than the prevention of disease by utilising the soil type which is unfavourable to the spread of disease. There is in St. Lucia at present a sufficient amount of infective material to destroy any ordinary cultivation within a year or so, and any future banana development (in the absence of immune varieties) could consist only of the Short Fig or the Bout Rond, and both of these are unsuited for transport by sea with present methods.

At the present time the greater part of the banana land is covered by a vigorous growth of low bush and shrubs, in close association with excellent stools of Gros Michel which continue to thrive and produce eight and nine-hand bunches.

Much useful knowledge was gained in the course of the five years work on bananas, particularly in connection with the soil, and this has a definite value in the development of any other crop under similar conditions. The data collected will be discussed in a future paper on soil changes in relation to tropical agriculture.

With regard to the economic value of the original banana lands, a suggestion is here made that the best areas would serve admirably for coffee development should any planter be sufficiently hardy to venture thereon.

From the above observations the writer ventures to suggest that more attention should be given to the soil conditions under which bananas thrive, as compared with soil conditions where bananas are largely subject to disease.

The writer wishes to acknowledge the generous, assistance of Dr. C. W. Wardlaw, PH.D., D.SC., in commenting on the foregoing notes during his tour in St. Lucia as Pathologist appointed by the Empire Marketing Board to investigate Panama disease.

Summary.

An account of the origin and growth of the Banana Industry in St. Lucia is given, reference being made to the co-operation of the local Agricultural Department with the developing Banana Company.

The occurrence of Panama disease, the measures taken against the disease, particularly in selecting only the best planting material, and a survey of the distribution of Panama disease throughout the Colony is discussed.

Soil conditions as affecting the general health of Gros Michel and variations in disease symptoms are noted.

The collection, shipment and transport conditions are discussed, and certain suggestions as to future methods of research on Panama disease based on habitat and ecological factors, conclude the paper.

DR. J. G. MYER'S VISIT.

DR. J. G. MYERS, M.SC. (N.Z.), SC.D. (Harv.), is expected to visit the West Indies and other parts of the American tropics early in 1929. Dr. Myers is a specialist in the study of the control of insect pests by their natural enemies, and in the course of his investigations it is expected that he will pay particular attention to the biological control of such pests as the moth borer of the sugar-cane, the sweet potato weevil, froghopper, and other well known pests of tropical crops. The Imperial Bureau of Entomology has selected Dr. Myers for this important commission, and the appointment has been made by the Colonial Office, and the Empire Marketing Board.

After consultation with the Principal it has been decided that Dr. Myers' headquarters shall be at the College, and the former will endeavour to give him every facility and aid in the prosecution of his researches. It is expected that a large amount of his time will be devoted to travelling and studying the conditions on the islands, and exploring new sources from which efficient parasites may be introduced. It is understood that he may be staying for two or three years in this area.

We have to acknowledge, with thanks, a copy of "Culture du Cacaoyer," by Dr. Paul Guérin, presented by Assistant Professor F. W. Urich, F.E.S., C.M.Z.S.

WITCH BROOM IN TRINIDAD.

BY THE HON. W. G. FREEMAN, B.SC., A.R.C.S., F.L.S.
Director of Agriculture.

THE Witch Broom disease of cacao owes its popular name to the characteristic growths which are produced on ordinary vegetative shoots and, to some extent also, on the reduced flowering shoots known as "cushions." A typical Witch Broom is shown in the illustration. It is an hypertrophied herbaceous growth, often three to four times the diameter of the shoot from the apex of which it springs. The nodes are short and the leaves frequently very small, but with stipules larger than normal. When the leaves attain larger dimensions they remain thin and flaccid. The Witch Brooms are at first green, but usually in the course of some six weeks to two months turn brown, wither and finally drop. Before dropping they may, particularly during periods of heavy rains, produce the characteristic fructifications of the Basidiomycete *Marasmius*

A TYPICAL WITCH BROOM.
(ABOUT NATURAL SIZE.) *Photo by F. W. Urich.*

perniciosus which is the causative fungus. These are of similar type to those borne by many Agarics, *e.g.*: the common mushroom, and about half to one inch in diameter; the upper surface of the cap is of a pale pink colour with a characteristic reddish black spot in the centre. The spores, by which the fungus is propagated, are produced on the gills on the lower side of the cap.

The disease is spread by these spores lodging on various parts of the cacao tree. When on ordinary vegetative growing points, infection takes place, a Witch Broom is produced instead of a normal extension of the shoot with leaves of ordinary size and texture. When infection of a cushion, or flowering shoot, occurs, a Witch Broom, with or without leaves, may be produced, or a more than usually abundant flower formation take place, so called star blooms, from which none, or only malformed pods are produced. Healthy pods may also become infected at apparently any stage of growth with the result that part of the pod becomes black, and very hard (thus differing from ordinary Black pod due to *Phytophthora Faberi*) and the disease spreads to the seeds within. Fructifications may be borne on infected pods.

The disease first came to notice in Surinam over thirty years ago. The cause was not known then, or for many years after. It spread from district to district and did great damage. Later it appeared in British Guiana and was also very destructive to the cacao which there formed a very minor industry. Ecuador was the other important cacao growing country to be inflicted with it, and here again great damage was done.

Favourable Conditions for the Fungus.

Most fungi, like other plants, require certain conditions in order to thrive and *Marasmius perniciosus* does not appear to be an exception. In Surinam and British Guiana cacao is grown mainly in low lying areas of constant high humidity. In Ecuador the conditions are also very humid, the cacao being often grown under the heavy shade of forest trees so that they grow very tall with their branches interlacing with the shade trees. This condition of constant high humidity in the places where Witch Broom has in the past proved destructive is of importance in connection with its occurrence in Trinidad.

Occurrence in Trinidad.

The disease is known in two principal areas about five miles apart, in very low lying land on either side of the Central Range Forest reserve, in the N.E. of the island; a very wet district with a rainfall of some 100-120 inches. One area is about 500 acres mostly in one block with a very few scattered trees outside it. In the second area the disease has been found through a piece of country, roughly the shape of an equilateral triangle, with sides four miles long. There is a block of 120 acres at one point and about 10 acres near another, and some 50 to 60 trees altogether at about ten places — mostly in the neighbourhood of the third point of the triangle. The incidence of the disease is most marked in the immediate neighbourhood of the rivers and streams with which the district is well supplied. Although, even in the worst portions, the attack is mild compared with descriptions of the damage done by the disease in Surinam, the evidence indicates that it has been there, unnoticed, for, at any rate, a few years. This, being the case, it is re-assuring to find that the disease has not spread over more or less circular areas, but has apparently only found suitable conditions in close proximity to the streams, *i.e.*: in the areas of greatest humidity.

Control Measures.

The Trinidad Government has taken active steps to control and eradicate the disease. A labour force under the supervision of officers of the Department of Agriculture has been continuously engaged in the affected areas. The properties, mostly the holdings of small proprietors, have been gone over, tree by tree, all Witch Brooms and diseased cushions removed, burnt, and wounds tarred. Two complete rounds have been made and the third is in progress. The few estates affected have mostly done similar work at their own expense. The general result has been a very great reduction in the number of brooms produced. These have now become scarce in the areas originally lightly affected, although still relatively plentiful in the worst areas. The work has however been accomplished sufficiently rapidly to secure as completely as possible the removal of the Witch Brooms whilst still in the green, *i.e.*: non-fruiting stage, before they have become sources of infection. In this we may have been assisted by the fact that the rains in the district have been considerably less heavy than is usual for the season of the year. Nothing is naturally known as yet of any seasonal periodicity in the fruiting of this fungus under Trinidad conditions, but careful watch is being kept and the plan of campaign will be modified if found necessary.

Up to the present, direct action to remove diseased growths before they have opportunity of fruiting, has mainly been resorted to. Action is also necessary by all owners of affected areas to make the conditions less congenial for the existence of the parasite. The measures indicated are attention to drainage, the gradual reduction of overhead shade, and the opening up of the cacao trees. In short the usual methods which have for long been advocated for the control of Black pod, which is most abundant and destructive to cacao grown under conditions of unduly high humidity and poor ventilation.

Much searching has been done by planters, many of whom have been to the affected areas, and by officers of the Department of Agriculture engaged continuously in field work throughout the island. All inspectors (planters and officials) for the Government Agricultural Bank pay special attention to the possible occurrence of the disease on properties they visit. An illustrated leaflet has been widely circulated, preserved specimens of Witch Broom placed on exhibition at Wardens' offices, &c., in country districts. So far no report has been received of the occurrence of the disease in any other of the important cacao growing districts of the Colony and it is hoped they will continue to have a clean bill of health.

Witch Broom of cacao is fortunately not a disease which spreads rapidly. The production of the brooms on the vegetative shoots does very little actual damage to the tree, until after long neglect when, as recorded in Surinam, trees get so heavily infected that they produce hardly anything but witches brooms. The damage done is due to the cumulative effect of the gradual infection of cushions and the infection of pods owing to brooms being allowed to remain on the tree and bear their fructifications.

The control measures necessary are therefore a constant sharp look out to detect the disease, careful and frequent (every two or three weeks) inspection of suspected trees and the removal and burning or burying of any diseased growths; attention to general sanitation, drainage and shade to make the conditions less favourable to the fungus which causes the trouble.

These measures, faithfully followed, should prevent the disease from establishing itself in any new areas in which it may appear. Meanwhile, continued action will be taken to secure the eradication of the disease in the areas in which it is known to occur.

TROPICAL WORLD NOTES.

Bengal.

The measures suggested by the Royal Commission on Agriculture to combat the problem of inaccurate jute crop forecasts, and the suggestion that this work should be undertaken by a central Jute Committee which, with an annual grant of Rs. 500,000, would also devote its energies to general improvements from "field to factory" are engaging the attention of jute brokers. Jute is at present a monopoly of India, says the report, but there is no guarantee that it will remain so. The danger that an artificial product may be discovered and placed on the market at a price which will enable it to replace jute, has to be faced. The history of indigo is a striking illustration of the possibilities in this direction. The situation is one which demands constant watchfulness. For jute to retain its present position it is necessary that every effort should be made to improve quality, outturn, and methods of manufacture, and to maintain the relative cheapness of jute as compared with other fibres. Unless this is done there is the risk that jute will cease to be cultivated, and that a blow at the prosperity of Bengal will be struck from which it will take long to recover.—(*The Chamber of Commerce Journal*, Vol. LVI, No. 760.)

* * *

Gold Coast.

According to *West Africa*, Vol. XII, No. 605 it was evident from the Acting Governor's speech, at the first meeting of the new Gold Coast Board of Agriculture, that official activity in connection with agriculture was to be modified by the sensible view that the African agriculturist knows what he wants, and that it was the duty of the Agricultural Department to place its specialised knowledge at his disposal, instead of trying to drive the farmer along paths that had only been tested by laboratory methods. Among other proposals, the Agricultural Department intends to run three large experimental stations in place of the many small ones at present in existence, and these will be at Kibbi, Kumasi and Tamale—that is to say, in areas typical of distinct branches of agriculture, where any new crop or improvement of old methods could be tried out on a thoroughly practical scale. The Agricultural Department itself is to be divided into four main sections, one dealing with research, a second with plant inspection, the third with statistics, and the fourth with economics, including agricultural education, the formation of co-operative societies, and the organisation of competitions. The keynote of the whole scheme is to be co-operation between the African farmer and the Government, and one of the first directions in which this co-operation can be shown will be in the use of the cocoa fermentaries which the Government propose to erect, following the system that has proved successful in Nigeria.

Montserrat.

Extracts of a letter which was written by the Curator after the hurricane which caused such havoc to the island on the 12th and 13th of September are published below.

"Needless to say that all agricultural work has had to be abandoned and everyone has had to concentrate on restoring roads, water supplies, shelter for the homeless, &c. At present the greatest need is sheltering homeless people. The native houses are badly destroyed.

The Botanic Gardens are a heap of ruins. The new experimental ginnery recently erected at Grove, which contained all our Self-Bolls and pedigree Seed Cotton from the breeding plots was wrecked. I have, however, been able to dry out all Seed Cotton and have no fear of losing our strains. The scarcity of shelter was so acute that my office has had to be turned into a shelter house for nearly 100 persons. I am, however, arranging other shelter for these people.

The Nurseries were badly damaged and most economic plants lost. As almost all fruit trees in the island have been destroyed, this is rather serious. If you can assist in obtaining a supply of economic trees and seeds to make a fresh start we shall be most grateful. In general all planting material of food crops are urgently required."

Prior to this communication he had written: "a very early and satisfactory cotton crop is being reaped." It is fortunate for the island that most of this crop was shipped before the disaster occurred.

* * *

Tongan Islands.

According to Colonial Report, No. 1388, the kingdom of Tonga consists of three main groups of islands which are situated in the Pacific Ocean between the 18th and 22nd degrees of South latitude and the 173rd and 176th degrees of West longitude, and extend over an area of approximately 250 square miles. Apart from foodstuffs produced by the Tongans for domestic use, copra is the sole agricultural product of the islands. Fifteen years ago, a considerable fruit export trade existed, but the absence of direct communication with New Zealand, which ceased during the war, has killed the trade. The following quantities and values of copra were exported for the last two years:—

Year.	*Tons.*	*Value.*
1926	13,992	£ 255,156
1927	11,252	225,344

The severe drought which prevailed during the latter half of 1925 and the first quarter of 1926 decreased copra production in 1927 which is almost entirely carried on by the Tongan landowners who are compelled by law to have four acres of their tax allotment of 8¼ acres properly planted with coconuts. A Copra Act was passed in 1926, having for its object the improvement in copra manufacture and it has been a statutory offence for a trader to have bad or damaged copra in his possession.

CACAO NOTES.

Gerold Stahel.

Beiträge zur Kenntnis der Blutenbiologie von Kakao (*Theobroma cacao* L.)

Verhandelingen der Koninklijke Akademie van Wetenschappen te Amsterdam, Afdeeling Natuurkunde (*Tweede Sectie*), *Deel XXV, No.* 6. (Contributions to our knowledge of the flower biology of cacao *Theobroma cacao* L.)

Dr. Stahel who is already well known for his work on the Witch-broom disease of cacao, here first describes in detail the structure of the cacao flower, and then proceeds to give an account of his experiments to determine the manner of pollination in Surinam.

He first of all reviews previous literature and points out that we are still inadequately informed about the floral biology of cacao. The only previous experimental researches on pollination are those which Harland (*Ann. Applied Biology* Vol. XXII, 1925) carried out in Trinidad.

His investigations demonstrated the fact that the majority of cacao flowers pass through their life-history without adequate pollination. It was found that in unpollinated flowers the number of pods finally set was about 0.3 per cent., while 90 per cent. of the flowers dropped in 24 hours. In flowers attended by ants and aphides about 2 per cent. of setting occurred, the difference in setting percentage being statistically significant. Adequate pollination took place in 35 per cent. of flowers attended by ants and aphides, and in only 6 per cent. of the controls. It was concluded that ants and aphides are the chief pollinating agents in the field under examination. Exclusion of crawling insects from a section of trunk by means of a sticky band demonstrated the presence of another pollinating agent, probably a night flying insect, which pollinated about 1 per cent. of the flowers. Experiments in which flowers were artificially pollinated resulted in an average setting of 5 per cent., varying from .4 per cent. to 13 per cent. in the different experiments.

In criticising the above experiments Stahel states that no exact proof was offered that ants and aphides, and not other crawling insects were really responsible for pollination, and also that the small number of fruits which developed between the banded portions of the trunk might have been either self-pollinated, wind-pollinated or pollinated by flying insects. This criticism is in part justified, though extended observations never revealed the presence of other crawling insects on those flowers which were marked as being attended by ants and aphides. Further, it was pointed out that prolonged shaking of the flowers to imitate the action of the wind, merely resulted in some of the pollen being shaken down into the petaloid hoods. A more crucial experiment carried out at a later date, demonstrated that when crawling insects were excluded from a section of trunk of the "male" cacao tree, which produces no pollen whatever, a small percentage of the stigmas were observed to have on them a cluster of 100 or more pollen grains. The pollen must necessarily have been conveyed either by wind or by flying insects. Wind as an agent must be rejected, as by reason of its habit of sticking together in masses, the pollen is not adapted for wind transference. Further, even if pollen were blown about by the wind the chances of a mass of pollen grains sticking exactly on the end of a stigma of a flower on another tree is incredibly remote.

Stahel considers the experiments on artificial pollination to be surprising in that only 5 per cent. of the flowers produced fruits, and it was this small percentage that led him to undertake a detailed series of experiments. He says: "if the stigmas were really adequately pollinated, as Harland states, why did only 5 per cent. of the flowers develop fruits? Even in preliminary experiments, I obtained better results, and by the employment of the best method succeeded in obtaining 80 per cent. of successes. If Harland, as I suspect, employed open anthers for pollination these would scarcely have any pollen left by 9 o'clock in the morning, and the bad results which he obtained would be explained."

It may here be stated that our pollinations were carried out between 7 and 8 in the morning, using either flowers which were picked in the bud stage the previous night, and kept in a desiccator, or flowers from the plot picked at the same time. In either case the stigmas were abundantly covered with pollen, and the adequacy of pollination checked with a powerful hand lens. The low percentage of successes is easily explained on two grounds. First, the plot was at the St. Augustine Experiment Station, in a very poor district for cacao, and second, the months in which the experiments were carried out were those of March and April in which there was no rain, and in which the general conditions were very unfavourable for the setting of fruit. Some of the trees on which pollinations were made were "bad setters," and in subsequent experiments many hundreds of pollinations were made without a single pod being set. Pollinations made during July, August and September in favoured localities resulted in 75-80 per cent. of successes.

Stahel apparently obtained his best results by pollinating at 5 o'clock in the afternoon during the month of March. Only 18 per cent. of fruits were obtained by pollinating one day old flowers.

In extensive observations on the manner of pollination Stahel observed the setting of fruits (*a*) under natural conditions, (*b*) between banded sections of trunk and (*c*) in carefully constructed cages from which insects were either excluded or, to which ants and aphides were admitted.

Of 1,785 flowers pollinated under natural conditions he observed 5.7 per cent. of fruits after 11 days. Of 3,409 flowers between banded sections of trunk 3.8 per cent. of fruits were found to have set after 11 days. Cages were placed over banded sections, and he obtained after 12 days .2 per cent. (1) fruit from 439 flowers. Subsequently several species of ants commonly

found on cacao trees were placed in cages, and from 624 flowers .8 per cent. (5) fruits resulted. The same cages were then used for ants and aphides together. At this time there were very few aphides in the cacao fields, and he therefore employed young shoots of citrus infested with aphides and attended by the small red ant, Solenopsis. Of 250 flowers with both ants and aphides 8 per cent. (20) of fruits resulted after 12 days. His experiments therefore led to the same conclusions as those of Jones and the present writer, that ants and aphides are responsible for a considerable amount of pollination. He considers also that various small flying insects are responsible for a good deal of pollination and rejects entirely the theory of wind-pollination.

Dr. Stahel's paper is well illustrated by good photographs, and it is to be hoped that more work will be done on this subject.

S. C. HARLAND.

COTTON NOTES.

The Influence of Environmental Conditions on the Development of the Angular Leaf-Spot Disease of Cotton.

R. H. STROUGHTON, B.SC., A.R.C.S., F.L.S.

Annals of Applied Biology, Vol. XV, No. 3, August, 1928.

THIS paper emanates from the Department of Mycology of the Rothamsted Experimental Station, and describes experiments on the artificial inoculation of cotton plants with the organism, Bacterium malvacearum, which is responsible for serious loss of crop in many cotton growing countries. The disease is almost universally distributed throughout the cotton growing countries of the world, and is particularly virulent in its effects on Egyptian cottons in the Sudan, and also on the native cottons of Nigeria. The disease presents three distinct manifestations according to the part of the plant attacked, (1) water-soaked spots on the leaves which develop into angular lesions delimited by the veins—the "angular leaf-spot;" (2) stem lesions producing the so called "black-arm" disease; and (3) water-soaked spots on the young bolls producing the typical "external boll-rot." The author obtained all three forms of the disease under glass house conditions in England by means of varied methods of artificial inoculation. At a humidity above 80 per cent. relative saturation, the limiting temperature for attack of B. malvacearum was 32°C., above which infection did not occur. At 70 per cent. relative humidity, infection was slight at 25°C. At lower humidities no infection was obtained at a temperature of 28°C.

The author states that the disease occurs to some extent on all species of Gossypium though some degree of varietal resistance has been reported. Recent observations in Trinidad indicate that some of the wild species of Gossypium are completely immune. The disease has not been seen so far on G. Stocksii, G. Davidsonii, G. Sturtii, and G. Tomentosum. The hybrid of Tomentosum x Egyptian shows susceptibility as marked as Egyptian, while the cross of Sturtii x Upland is attacked though not badly. It appears that susceptibility to the disease behaves as an almost complete dominant. The only cottons which are attacked at all badly in Trinidad are of the Egyptian type, and it has been found easy to isolate from crosses of Egyptian x Upland both relatively immune and susceptible strains. In Trinidad the genetic constitution of the plant appears to be far more important in limiting attack than environmental conditions.

S. C. HARLAND.

ELEPHANTS IN BELGIAN CONGO.

Mr. E. Dejong, Director of the Bambeza Cotton Station makes a brief reference in *Agriculture et Elevage au Congo Belge* (No. 18) to ploughing trials carried out with elephants and tractors working under similar conditions. It was found that elephants are much better and much cheaper for this type of work than tractors. They are not, like tractors, hampered by the wetness of the soil during the rainy season when most of the ploughing is done, and are said to overcome such obstacles as white ants' nests and boulders with the greatest of ease. Where there are particularly heavy obstacles in the way elephants will stop instinctively, and in this respect are much superior to a tractor, which under the control of a native, may do serious damage by forcing tackle over such obstacles. Elephants work faster and are easier to keep and to control. Finally, Mr. E. Dejong gives some interesting figures as to the comparative costs of maintaining a team of two elephants and a tractor for one year. By supposing that one tractor and a team of two elephants will each plough 100 * hectares per year where petrol costs 7 † francs per litre, (Uelé-Népoko) he works out the cost per hectare as follows:

1 Tractor.	*francs.*	2 Elephants.	*francs.*
Petrol ..	350	Food	1
Oil	126	Labour ..	36
Mechanic ..	18	Depreciation ..	20
Depreciation ..	108	Vet. Attendance ..	2
Repairs ..	21		
Total francs	623	Total francs ..	59

From these figures it is contended that by using a team of elephants frs. 564 can be saved per hectare, or frs. 56,400 per year. The cost of the elephants' food, however, appears to be exceptionally low, and it would be interesting to have additional details on this item.

* Hectares = approximately 2½ acres.

† Belgian franc = 6·857 pence.

G. G.

TIMBER.

Reports of the Imperial Economic Committee. Tenth Report.

IN brief, this Report, which has been prepared under a resolution of the Imperial Conference of 1926, and appears in time for discussion at the British Empire Forestry Conference now being held in Australia, after indicating the present position with regard to the imports of timber into the United Kingdom and the past efforts made to encourage the use of Empire Timbers, describes the trade organisation in imported timber, the sources from which the imports of softwoods and hardwoods are derived, and the resources and trade in home grown timbers; it then refers to the conditions of successful competition with supplies from foreign sources and the special features peculiar to timber in this connection, and details the steps which should be taken for the successful introduction of new or unfamiliar timbers. Tables of Imports of timber (softwoods for 1927 and hardwoods for 1926) compiled from the Trade Returns of the United Kingdom, and a list giving a few instances of the use of Empire Timbers in Works and Buildings in Great Britain are attached as Appendices.

On the subject of imports it is shown that in 1926 of the total imports of raw timber into the United Kingdom 75 per cent. were softwoods, and that of this amount of softwoods, 94 per cent., was drawn from foreign sources: further, that, despite the vast wealth of hardwood timbers in the British Empire, only 30 per cent. of the imports of hardwoods came from Empire sources, half of this 30 per cent. being Teak, of which the Empire possesses practically a monopoly.

The situation is even less satisfactory when it is remembered that at the British Empire Forestry Conference in 1923 emphasis was laid on the fact that future supplies from Europe and North America, which are the principal sources of the commercial supplies of softwoods, are regarded with grave anxiety. It was pointed out that in Europe the annual home utilisation of softwoods exceeded the annual increment by about 2,250 million cubic feet: and that in the United States the original forest area of 822,000,000 acres had been reduced to 463,000,000 acres of which only 137,000,000 carried virgin timber, whilst standing timber was being cut at the rate of more than four times the estimated annual growth. The United Kingdom is thus dependent for 75 per cent. of its softwoods on foreign supplies which are showing indications of approaching exhaustion; an extended use, therefore, of British Columbia softwoods, available to the United Kingdom *via* the Panama Canal, is advocated, and also the search by Forest Departments throughout the Empire for lighter hardwoods which may be suitable as substitutes for softwoods.

The successful introduction of new or little known timbers, however, to the British market is no easy matter. Users of timber are essentially conservative and a new timber has to compete with established timbers whose properties are well known and accepted. The Report points out, therefore, the necessity for regularity of supply, investigation of technical qualities, grading, suitable nomenclature, and so on, in order to make a new timber acceptable to the British user, and recommends that the Forest Products Research Laboratory at Princes Risborough should undertake investigations with Empire Timbers as one of its normal functions.

Finally it is urged that public bodies and big companies should exercise their voluntary preference in favour of Empire Timbers. Although economic and geographical considerations may forbid the exclusive use of Empire Timbers, it is clearly the duty of all the countries of the Empire to join in a policy not only of the scientific management and development of their own forest resources, but also of the utilisation, whenever practicable, of Empire, rather than foreign, timbers.

R. L. B.

TOGOLAND FORESTRY CONDITIONS.

The Empire Forestry Journal, Vol. VI, No. 2, (1927), contains a paper by Mr. J. R. P. Gent on "Forestry Conditions in Ho District, Togoland," which though primarily concerned with but a limited area, supplies an object lesson no doubt applicable to other parts of the same zone in West Africa. The Ho District lies to the East of the Volta in the British Mandated Territory south-south-west of the old German station of Misahohe. Its forests are in part Deciduous Rain Forest, in part Savannah Forest; the former having escaped the depredations of man chiefly in uninhabited areas, inaccessible spots, or other specially favoured localities. Elsewhere, the natural conditions are so delicately balanced that any unnatural interference with them leads to a transition towards the savannah forest, a type specially adapted to survive the two primary enemies of vegetation-aridity (of soil or air) and fire. The writer is led to the conclusion that in this area the forest once covered much more ground, but has long been deteriorating, not because the natural conditions are unfavourable (the drying harmattan winds being the only adverse factor on this side) but owing to man's action, principally the native custom of shifting cultivation and grass-burning in the dry season. The spread of cacao cultivation also intensifies the attack on the forest, and such perennial crops are held to be generally unsuited to an area exposed as this is to drying winds. It is urged that efforts should at once be made to check further deterioration of the climatic conditions by the creation of forest reserves. This could still be done in the hill ranges to the north, little touched as yet by modern conditions, though in the more southern parts things have already gone too far for anything but local palliatives.—(*The Geographical Journal*, Vol. LXXII, No. 3.)

TRINIDAD COCCINELLIDAE.

The Control of Aspidiotus Destructor.

AN interesting account appears in the *Fiji Agricultural Journal* (Vol. I, No. 1), by Mr. T. H. C. Taylor, Assistant Entomologist to the Fiji Department of Agriculture, of the progress made in the control of Aspidiotus destructor or Coconut scale by means of five species of the Trinidad Coccinellidae beetles which he recently introduced into that island and of which the following numbers were landed alive in Trinidad cages :—

(1) *Cryptognatha nodiceps, Mshl* ..	1,517
(2) *Azya trinitatis, Mshl*	162
(3) *Pentilia insidiosa, Muls.* ..	22
(4) "Spotted" sp. (unidentified) ..	69
(5) "Small" sp. (unidentified) ..	400

Of these species, *C. nodiceps* was the only one that bred satisfactorily and that was not heavily attacked in the Fiji cages by ants which almost wiped out species (3), (4) and (5). The difficulties presented by any attacks were, however, largely overcome by tanglefooting the cages and varas, but the stock of beetles, in the meantime, had become so depleted in all species except *C. nodiceps* that it was necessary to resort to the practice of breeding in tubes. This method presented many difficulties but saved the situation. The success of *C. nodiceps*, in spite of ants, was attributed to the fact that it was present in much larger numbers from the first and that, owing to its short life cycle, its rate of multiplication was much greater than any of the others. Two colonies of this specie were liberated and according to reports the beetle seems to have firmly established itself.

Azya trinitatis has been very disappointing. In Trinidad, except for *C. nodiceps*, this is the most efficient species, yet in Fiji it will scarcely breed at all; and although ants have been troublesome at times they are now completely excluded. The only explanation that was offered for the failure of *Azya* is that there is some difference between the scale in Fiji and that of Trinidad.

Adults of *P. insidiosa* laid well in tubes, but the majority of the eggs obtained in this way were killed by mildew on the strips of leaf on which they were laid, a difficulty which has now been overcome.

"Spotted" sp. is promising but was attacked by ants. "Small" sp. is the only species attacked by ants in the adult as well as in the early stages. One colony of these has been liberated.

The following conclusions were reached :—

1. The Trinidad *Coccinellids*, considered together, promise well.
2. *C. nodiceps* is almost certainly established in Fiji.
3. *C. nodiceps* is certainly the most promising.
4. Satisfactory methods of breeding all the species, except *A. trinitatis*, have now been evolved.

It will be remembered that Mr. Taylor spent several months at the College, conducting research work on these beetles. G. G.

REVIEWS.

SEED TESTING, J. S. Remington, Sir Isaac Pitman & Sons, Ltd., London 1928.

A good general survey of the ground covered by "Seed testing" has been given in this book. The introduction deals briefly with the history of seed testing from its inception on the continent to its present day position of great importance. It is especially interesting to the English farmer as so much of his grass and clover seed is imported from overseas.

The chapter on sampling rightly emphasises the importance of exercising care; careless sampling may render the results obtained in subsequent germination tests quite useless.

It is to be feared, however, that the apparatus described for use in the germination test, whilst interesting to students, will be more calculated to deter than to encourage the farmer to test his own seed stocks. Useful tests can be carried out by much simpler means and it is not absolutely essential to have a specially heated incubator, the test being done at room temperature. The information on cereal testing is rather scanty. Oats receive no mention at all and there is no reference to the artificial "ripening" of wheat and barley samples, by heating in a dry incubator previous to making the germination test.

The grasses and clovers are also dismissed with but brief mentions. Special notes on recognizing the country of origin of the sample from the weed seeds present would have been useful. There are a large number of spelling mistakes in the Latin names which might have been corrected.

R. E. H.

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RURAL ECONOMICS IN INDIA — Sir Alfred Chatterton, K.C.I.E. The Russell Lecture, 1926, Patna University. Oxford University Press. pp. 30. Price 1s.

The lecturer points out that India is undergoing a period of transition, to face which she is ill equipped by her system of education, which tends to stimulate mental development, without however, affording it means whereby it can be translated into beneficent activity.

The prime necessity therefore to-day is to search for a means to provide for the profitable utilisation of this stimulus to a constantly increasing amount, in a great diversity of forms of human activity, and Sir Alfred finds, at any rate one such career in the leadership of village life and the bridging of the gap between the Agricultural Department and the ryot peasant. The ryot needs to be raised, as the recent Royal Commission puts it, to a "will to live better": to be cured of his thriftlessness, and of his "acceptance of indebtedness as a settled fact and a natural state of life."

He needs leaders; the field of work is a large one, the labourers are at present, it is feared lamentably few.

R. C. W.

OLD TRADES AND NEW KNOWLEDGE. By Sir William Bragg G. Bell & Sons. Price 7s. 6d.

It is indeed fortunate that this series of six Christmas lectures delivered at the Royal Institution in 1925 to 'a juvenile auditory' has been made available to a larger audience than can be accommodated in the lecture theatre. The interest of the lectures is wide. Every intelligent juvenile, whether he be scientifically minded or not, will find them of value in appreciating the trend and growth of modern industrial processes.

Sir William Bragg has an intimate knowledge of the wide range of subjects covered. He explains each scientific development and its industrial influence with an admirable lack of scientific terms. He shows how science has eventually become the servant of commerce. He shows how an intimate knowledge of the properties and structure of the molecules themselves is essential for the complete control of the raw material. The dyer with a complete knowledge of the structure of his dye molecule is using reasoned control of his methods, while the potter with an incomplete idea of the structure of his clay particle relies largely on empirical control.

Sufficient compliment to the value of the lectures for the promotion of scientific interest is paid by the establishment in America of a similar series.

H. H. C.

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PLANT RESPIRATION. By Dr. S. Kostychev. Translated and edited by C. J. Lyon, PH.D. P. Blakiston's Son & Co., Philadelphia, 1927.

In the absence of a really satisfactory text-book dealing with plant physiology as a whole, works which collect and arrange the available information in sections of the science are doubly welcome. Dr. Kostychev's treatise deals fully with its title subject, and will prove of value to many specialist workers in this field.

E. E. C.

ST. VINCENT ARROWROOT.

WE have just received an attractive pamphlet on "The St. Vincent Arrowroot" which has been published for the St. Vincent Arrowroot Growers' Association by the West India Committee. Part I of the Pamphlet, written by Dr. John Campbell, Hon. Scientific Adviser to the St. Vincent Arrowroot Growers' Association, deals with the general properties of the root as a food, while Part II contains a large number of practical recipes, specially prepared by Mrs. Ettie Hornibrook. The object of the pamphlet which can be obtained, free of charge, from the Secretary, the West India Committee, 14, Trinity Square, London, E.C.3., is to popularise the St. Vincent Arrowroot as an Empire product.

BOOKS RECEIVED.

WE have to acknowledge the receipt of the following books:—

AGRICULTURE.

The Agricultural Development of Arid and Semi-arid Regions. H. D. Leppan. *South Africa Central News Agency*, p. 280.

The Scientific Feeding of Animals, p. 328. *O. Kellner, Duckworth, 8s. 6d.*

Goat Grazing and Forestry in Cyprus. A. H. Unwin, p. 164. *Crosby Lockwood & Son, 7s. 6d.*

CHEMISTRY.

The Colloid Chemistry of the Rubber Industry. E. A. Hauser, p. 56. *H. Milford, 5s.*

Hexosamines and Mucoproteins. P. A. Levene, p. 164. *Longmans, Green & Co. Ltd., 10s. 6d.*

ECONOMICS.

Cost Accounting Applied to Agriculture. J. S. King, p. 182. *Oxford University Press, 7s. 6d.*

GENERAL.

Times of Ceylon Green Book, 1,450 pages. *Times of Ceylon, 10s. 6d.*

Intermediate Commercial Geography. L. D. Stamp, p. 362. *Longmans, Green & Co. Ltd., 7s. 6d.*

CORRESPONDENCE.

THE EDITOR,
"TROPICAL AGRICULTURE."

DEAR SIR,

In my article on the Dacca Research Station *Tropical Agriculture*, Volume V, pages 75-78, I stated that Artificial Farm Yard Manure can be made by fermenting vegetable refuse with dilute solutions of Salts of Ammonia in the presence of phosphate. The article proceeds to state that "the same of course applies to the Rothamsted preparation 'Adco' which is however more expensive."

It has been pointed out to me that although the preliminary work which enabled "Adco" to be put on the market was done at Rothamsted, the Company which is now preparing and selling "Adco" has nothing to do with Rothamsted. Figures have also been placed before me which indicate that the information supplied to us regarding quantities and prices of "Adco" was defective. On this account the cost of manure prepared from "Adco" seems less than we were originally led to believe, and I therefore think it well to withdraw the statement regarding the relative costs of preparing manure with "Adco" and with other sources of Nitrogen.

Yours faithfully,

(*Sgd.*) ROBERT S. FINLOW.

CHEMICAL NOTES.

Compiled by the College Department of Chemistry and Soil Science.

Petroleum Oil in Insecticides.

Water is an almost universal dilutent for the purpose of spreading and spraying insecticides. Its popularity is due mainly to its cheapness and to its general solvent power for insecticides. It lacks, however, many properties necessary to obtain full effect from the insecticides. It has poor spreading power due to its high surface tension, and small cohesion for solids. It has poor penetrating power due to its inability to dissolve plant or insect wax. The former deficiency has been overcome by the introduction of spreaders, such as soap and casein, to lower the surface tension of the solution, but the penetrating power is not simultaneously increased.

Highly refined petroleum fractions are safe to use on plants, and possess many of the properties lacking in water. The refining process, however, removes much of the insecticidal power of the oil. Oil-water emulsions possess good spreading power and are fairly good wax solvents, and have, therefore, good penetrating power. A toxic substance may be introduced to replace the lost toxicity of the oil, and is carried into the leaf or insect with the oil. Experiments with nicotine have shown that a nicotine-water-oil emulsion is far more efficient than a simple nicotine-water solution. The difference is due to the physical effect of the oil. The principle is applied commercially in certain fly sprays containing pyrethrum extract.

Care must be taken in choosing an oil, as some are liable to damage foliage, or may disturb the plant. Thus, prune trees in California have their blooming period retarded if sprayed with oil in November, advanced if sprayed in January, and not affected if sprayed in December. It is claimed that oil sprays reduce the injury caused by drying winds on lemon and orange trees.—(*Ind. and Eng. Chem.* 20, 826.)

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The Phosphate Requirements of Grass.

The phosphate content of grasses grown near Frieburg, British Bechuanaland, has been examined. The grasses were growing on a soil deficient in phosphoric acid and suffering from lack of rain. The young grass leaves had a normal content of phosphate but at later stages there was a pronounced deficiency. The original phosphate absorbed was rapidly transformed into organic complexes, and there was apparently little remaining available for seed formation. Poor yields resulted. Applications of phosphatic fertilizers increased seed formation, and by watering at the time of application the yield was increased further. The effect of watering alone is not stated. M. Henrici, by whom these experiments were reported, states that the primary cause of poor seed formation is a deficiency in phosphate.—(*Superphosphate*, Vol. I, 124.)

Avocado Oil.

If the pulp of the avocado fruit is dried, an oil suitable for the manufacture of hard soap can be expressed or extracted. The properties of this oil have been re-examined by Jamieson, Baughman and Mann (*Oil and Fat Industries*, 1928, 5, 202). It is dark green by transmitted light and red by reflected light. It can be partially bleached by Fuller's earth. It contains glycerides of the following acids, oleic acid 77.3 per cent., linoleic acid 10.8 per cent., palmitic 6.9 per cent., and a trace of stearic and myristic acids. The oil has good keeping qualities. The dried pulp is 68-85 per cent. of the fruit, and contains about 70 per cent. of oil.

* * *

Mauritius Sugar-Cane Manuring Experiments.

In a paper read at the Mauritius Sugar Conference by the Director of Agriculture, Dr. H. A. Tempany (*South African Sugar Journal*, 12, 7. July 31st, 1928, pp. 419), the results of thirty-five years experience in manuring the sugar-cane crop are presented and discussed.

The use of replicated plots in considerable numbers has rendered the results reliable. The conclusions reached may be summarized as follows.

1. Manuring is intensively practised in Mauritius. The materials employed include heavy dressings of pen manure (20 to 30 tons per acre) combined with molasses or factory scums and with artificial fertilizers containing nitrogen, potassium and phosphorus.

2. Where large dressings of manure and molasses are applied, especially to plant canes, there appears to be no additional advantage in adding fertilizer salts as well.

3. There is no advantage in applying artificial fertilizers in more than one dressing, provided this is given early in the growth of the crop.

4. Artificial fertilizers added to one crop show no residual effect on the next succeeding crop.

5. Molasses is a beneficial manure for lands in Mauritius that have not yet reached the limit of productivity.

The soils of Mauritius are characteristically lateritic and have been derived from basaltic igneous rock. The top soil rarely exceeds ten inches in depth. According to Dr. Tempany, the shallowness of the top soil is the chief limiting factor in sugar-cane production in Mauritius. The top soil, however, is naturally highly fertile, containing a high proportion of nitrogen. (This may account for the fact that molasses does not depress plant growth as would be expected were the soil initially deficient in nitrogen).

Dr. Tempany stresses the observation that the application of nitrogenous fertilizer-salts along with organic nitrogenous manures, as practised in Mauritius, is theoretically unsound, because nitrogen losses might result therefrom. He recommends instead that the fertilizer salts be applied some time after the organic manure has been added.

SUGAR NOTES.

Compiled by the College Department of Sugar Technology.

Influence of Phosphate and Colloid Contents on Defecation of Cane Juice.

A paper by H. S. Paine, J. C. Keane, and M. A. McCalip (I.E.C. 20, No. 3, 262-267) describes a series of large-scale laboratory defecation experiments made during the recent season in P.R., which showed many significant facts concerning cane juice clarification. The first series of tests made on raw juices which varied considerably in composition, particularly as regards P_2O_5 content, showed the effect of varying the pH. The samples limed the least gave defecated juices with an average pH of 7.18, and the average colloid elimination in this group (limed to the lowest pH) was 18.3 per cent., and while the average CaO content was 0.2899 grm. per 100° Brix, the average pH value in the second group of defecated juices was 7.71, and the average colloid elimination was 22.3 per cent., which is a distinct increase over the group of lowest pH. The lime content, however, was increased to 0.3163 grm. per 100° Brix. The defecated juices of group 3 (average pH value 8.05) gave the greatest average colloid elimination, namely, 25.3 per cent., but the CaO content was again increased, averaging 0.3572 grm. per 100° Brix. The average apparent purity of the three groups of defecated juices was approximately the same. From these data it is concluded that colloid elimination is unquestionably greater at the higher pH value. Increase in the quantity of lime increases the colloid elimination but likewise the volume and weight of mud. In addition, it also increases the lime salts content of the clarified juice. But the question as to whether the benefit derived from increasing the colloid elimination from 18.3 per cent. to 25.3 per cent. by increasing the quantity of lime is sufficient to offset the detrimental effect of increasing the CaO content from 0.2899 grm. to 0.3571 grm. per 100° Brix should be considered carefully. It was found later that the CaO content of the juice bears an approximately linear relation to the content of colloids of reversible type. This relation is of considerable significance. It indicates a detrimental effect of a high content of lime-salts on certain phases of the raw sugar process and the importance of avoiding the addition of lime in excess of a quantity which can be utilised profitably during defecation. Excessive liming in defecation has generally been considered principally from the standpoint of scale formation on heating surfaces, but a consideration of at least equal importance is its adverse effect on boiling-house operations owing to an increased quantity of viscous colloidal material in addition to lime-salts. Following this, the effect of the phosphate content on colloid elimination was studied, and it was observed that the phosphate content of the raw juice, an important constituent from the standpoint of clarification by simple lime defecation showed an approximately linear relation to the colloid elimination as determined by the dye test. The increased colloid elimination at higher phosphate content was accompanied by an increase in the weight and volume of mud. With increasing phosphate content of the raw juice the rate of increase in volume was greater than the rate of increase in weight of mud. This is of significance in connexion with defecation capacity. Other points which emerged were the following: Juice at the factory where the experiments were carried out (Central Fajardo, P.R.) being deficient in phosphate content, it was defecated with and without the addition of phosphate, the juice being limed to the same pH value in each case. A comparison of the two groups showed a decided increase in colloid elimination as determined by ultra-filtration, an average relative improvement of 70 per cent. for irreversible colloids, and 28 per cent. for total colloids in the case of addition of phosphate. A distinct reduction in lime compounds per 100° Brix was noted in juices which had been defecated after addition of phosphate. Later, a number of samples of juice were defecated by single and double defecation, the procedure being as nearly as possible that used in sugar house operations. The colloid elimination by dye test was distinctly greater in double defecation, which method also gave a larger rise in apparent purity as well as a slightly better general appearance. This is attributable, in a measure at least, to colloid elimination by acid defecation of the low purity juices where the quantity of mud is proportionately large.—(*International Sugar Journal*, 30, No. 355, p. 388.)

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The Re-action between Amino Acids and Glucose.

PRELIMINARY experiments with analine and glucose show that when the amount of the amino acid is small compared to the amount of glucose, acetaldehyde is formed, accompanied by an extensive destruction of the reducing sugar by dehydroxylation. When, however, the amount of amino acid is large, both CO_2 and acetaldehyde, in equimolecular quantities, are formed, and the melanoidins produced have a different composition than in the former case, being noticeably lower in carbon contents. With glycocol and glucose, no formaldehyde was found, presumably because of its immediate union with unchanged amino acid. With asparagin, acetaldehyde is evolved. The course of the re-action is influenced not only by the relative concentrations of the re-agents, but also by the temperature and duration of heating and the removal or non-removal of the volatile products. The melanoidins formed promote frothing by a lowering of the surface tension, but, in molasses, &c., the production of gas must be formed from some other source than the amino acid-reducing sugar re-action. There is a great need for further fundamental research on this re-action and its bearing on sugar manufacture.—(*J. A. Ambler, Bureau of Chemistry and Soils.*)

SAN THOMÉ CACAO INDUSTRY.

Photo by *F. W. Urich.*

Part of Roça showing labourers barracks with Hospital in background.

Photo by *F. W. Urich.*

Foreground : Cocoa drying trays.
Background : Fermentation boxes and offices.

The late Mr. G. C. SKINNER.

OBITUARY.

Mr. Gilbert C. Skinner.

IN the last issue of *Tropical Agriculture* a brief mention was made at the time of going to press of the sudden death in London, on 5th September, of Mr. G. C. Skinner. His death, at the early age of 41, has created a gap in Trinidad, as he was a great influence in the cause of agricultural improvement.

He had occupied the important position of General Manager of the Ste. Madeleine Sugar Co., Ltd. (one of the biggest cane sugar making and growing Companies in the British Empire) for the last four years. During this short period it is safe to say that he had worked wonders and had done much to make this concern a prosperous and efficient undertaking. By training an accountant, he rapidly showed, on assuming the position of General Manager, that he had a thorough grasp of the agricultural problems involved, and was always ready to carry out experiments and to seek advice from scientists with a view to improving the field system practised on the Estates of the Company and introducing improved methods. He had a genuine love for the land and anything connected with agriculture, and from the start took the greatest interest in the progress of the Imperial College of Tropical Agriculture, of which he was appointed a Governor in 1927. He was in intimate contact with the College staff and a most prominent and energetic member of the Froghopper Committee.

He was personally a quiet and unassuming man, but his personality was generous and charming and his character was so honest and sincere that he rapidly won the confidence and esteem of all who came in contact with him.

At the meeting of the Governing Body of the College held at the Colonial Office, Whitehall, on 12th September, 1928, the following resolution was moved from the Chair, all members present standing in their places :—

That the Members of the Governing Body have learnt with deep regret of the death of their colleague Mr. Gilbert C. Skinner, which occurred on 5th September, and that the expression of their sincere condolence and sympathy be conveyed to Mrs. Skinner and his family.

His loss will not only be greatly felt by the Ste. Madeleine Sugar Co., but also by all Agricultural interests in the Colony of Trinidad, as he had risen to the position of being considered one of the soundest and most progressive agriculturists in the West Indies.

G. E.

CO-OPERATION IN MADRAS.

THE 13,000 Co-operative Societies in Madras have recently been the subject of examination by a Committee of officials and non-officials appointed by the Government. Most of the Societies are small credit organisations possessing an aggregate membership of 800,000 and a working capital of £10,000,000. Heavy arrears of repayments have occasioned considerable anxiety and the aim of the enquiry was to ascertain whether the situation was due to unwillingness or inability to repay. The Committee ascribes the situation to a combination of both factors. In many cases inadequate effort to repay is made because the borrower fails to realise the nature and obligations of his loan, and the accumulating debt, through the negligence of the Society's officials and himself, eventually becomes overwhelmingly large.

A powerful factor has been the failure to differentiate between long and short term loans, both of which have been recorded in the same account. The Committee sensibly recommends that separate ledgers should be kept for each type of loan, and that there should be distinctively coloured forms of bond, which will enable even the illiterate to appreciate their difference. Short and long term debts will be separately recorded in the balance sheets. It is also suggested that overdue loans should promptly be transferred to a special ledger. While these proposals appear to conflict with a plea for the reduction of records, they are nevertheless to be welcomed as a means of minimising the effect of a confusion so potent in causing overdue loans.

Recommendations are made for improving the efficiency of the supervisors whose function it is to educate the villagers in co-operative matters. It is suggested that they be trained by the Co-operative Union of the Province through the agency of the district federations, and that they be required to pass an examination approved by the official Registrar of Co-operative Societies. Since so many failures can be attributed to co-operative ignorance it is essential that those responsible for educating the members should be efficient.

As a means of tightening up the administrative machinery the Provincial Co-operative Bank will inspect the 30 district banks, while the district banks will inspect the 13,000 primary Societies which they finance. In the event of serious default the bank will notify the local federation to exert pressure on the Society concerned, and it will be the duty of the supervisor to ensure an improvement or recommend the dissolution of the Society. This definite allocation of duties and responsibilities is essential to the efficient functioning of the system, and to its neglect must be attributed many failures. These, with other measures, should be instrumental in ameliorating the conditions examined. It is to be regretted that some of the systems in our Crown Colonies have not been subjected to the same sympathetic criticism.

C. Y. S.

COLLEGE NEWS.

Mr. J. H. Aikman, Assistant Accountant, returned from Canada by the s.s. *Canadian Volunteer* on the 5th October.

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Dr. C. W. Wardlaw, Pathologist to the College Banana Research Station, left for Panama by the s.s. *Ariguani* on the 23rd September.

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Six temporary quarters have been erected close to the Hostel to provide additional room for the students in residence this year.

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Mr. and Mrs. R. E. Hunter sailed for Grenada by the s.s. *Mayaro* on the 1st September and returned by the s.s. *Maraval* on the 14th September.

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Mr. T. R. Hayes, M.SC.TECH. (Manchester), Superintendent of Agriculture, Gambia, arrived from England, via Jamaica by the s.s. *Coronado* on the 5th October.

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Mr. E. N. de Lestang, agricultural diplomate in engineering of the Institut Agricole d'Algérie and Inspector of plantations, Seychelles, arrived from England by the s.s. *Simon Bolivar* on the 28th September.

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We learn that Mr. R. M. Steven has been appointed Produce Inspector in Nigeria. His appointment is of particular interest, as he is the first College Diploma student to secure a post under the Colonial Office.

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The Principal, Professor and Mrs. H. A. Ballou, Dr. and Mrs. H. R. Briton-Jones, Dr. Laurence McGuire, Banana Research Physiologist, and Mr. A. K. Briant, Lecturer in Mycology, arrived from England by the s.s. *Ariguani* on the 23rd September.

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Mr. E. E. Cheesman, Professor of Botany and Genetics and Mr. P. E. Turner, Lecturer in Chemistry specially seconded for research work in cane soils under the auspices of the Froghopper Investigation Committee, returned from England by the s.s. *Simon Bolivar* on the 28th September.

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Mr. H. A. Ballou, Professor of Zoology and Entomology and Commissioner of Agriculture for the West Indies sailed by the s.s. *Venezuela* on 2nd October for the Leeward Islands which he will visit in connection with the recent hurricane. He is expected to return to Trinidad on the 19th October.

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Dr. E. A. Seagar, Professor of Tropical Sanitation and Hygiene, arrived from England by the s.s. *Carare* on the 7th October. He was accompanied by eighteen Colonial, seven Empire Cotton Growing Corporation, two Special and three Diploma students. Five Diploma students arrived from Barbados by the same opportunity.

The following have recently visited the College: Messrs. A. Moody-Stuart, H. A. Moller, A. L. Collins, W. H. Carden, S. Lister-James and N. Vucosavovich.

Mr. J. A. Wirshing, President of the Porto Rico American Sugar Refining Inc., visited the College on 12th October, in the company of his son who has come up to take the three year's Diploma course.

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Mr. J. G. Davies arrived by the s.s. *Canadian Skirmisher* on the 1st September from British Guiana. Mr. Davies who was educated at St. Dunstan's College, London, was one of the first students to be awarded the College Sugar Certificate and is a diplomate and an associate of the Imperial College of Tropical Agriculture. During the past year he was assistant chemist at the Blairmont Central Factory, Berbice. He has been appointed full-time Sugar Technologist and, under the direction of Professor Scott, will take charge of the College Sugar Factory during the coming season.

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Dr. Laurence P. McGuire who has been appointed Plant Physiologist for banana research under the Empire Marketing Board was educated at the Marish Brothers' College, Uitenchange, South Africa and the Natal University College where he obtained in 1921, a B.SC. degree, and in 1922, an M.SC. degree (hons.) in Chemistry and Botany. After conducting research work on the ripening processes of the pineapple with a view to improving the conditions of exports of this fruit to England, he was elected to a Dominion Science Scholarship and proceeded, in 1924, to the Royal College of Science, London, where he was awarded a PH.D. and D.I.C. for biochemical research on plant proteins. After spending some time at the Low Temperature Station, Cambridge, he was appointed on the staff of the Department of Agriculture, South Africa, where he carried out cold storage trials on apples and avocado pears. He returned to Cambridge for some months prior to taking up his appointment at the Imperial College where his main activities will be confined to banana cold storage problems.

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APPOINTMENTS.

The following appointments of students in residence at the College during the session 1927-28 have been notified by the Secretary of State for the Colonies:—

Mr. O. J. Voelcker, B.A., Superintendent, Agricultural Department, Nigeria.

Mr. G. N. K. Turnbull, Superintendent, Agricultural Department, Nigeria.

Mr. J. H. Palmer, B.A. (Agric.), Superintendent, Agricultural Department, Nigeria.

Mr. E. W. Leach, B.SC. (Agric.) Superintendent, Agricultural Department, Nigeria.

Mr. G. Cowan, N.D.A., C.D.A., Superintendent, Agricultural Department, Gold Coast.

Mr. H. P. Smart, B.SC., Agricultural Officer, British Honduras.

Mr. E. B. Martyn, B.A., Botanist and Mycologist, British Guiana.

COLLEGE SESSION 1928-29.

The College session for the year 1928-29 commenced on the 8th October. The following Students are taking the Diploma Course :—

1st Year :

Messrs. B. W. G. Austin, H. L. Manning, and D. S. Cozier (Barbados) ; C. B. Gregory (British Guiana) ; G. Briggs (England) ; J. A. Wirshing (Porto Rico) ; C. L. MacDougall (Peru); J. de la Bastide and J. L. Goellnicht (Trinidad).

2nd Year :

Messrs. E. S. A. Chin and J. F. Williams (British Guiana) ; A. F. Nichols and C. A. S. Hynam (Barbados) ; and C. K. Robinson (Trinidad).

3rd Year :

Messrs. R. S. Hanomansingh (British Guiana) ; H. L. Grogan (Barbados) ; and A. W. F. Sheffield (England).

4th Year :

Messrs. J. A. McDonald (Antigua) ; L. S. Birkett (Barbados); and A. C. G. Palmer (St. Lucia). For Sugar Technology.

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The Colonial Office Students are as follows :—

Mr. W. Cook, Nat. Sc. Trip., pts. I and II (Cantab.).
Mr. E. W. Gaddum, B.Sc. Agric. (London).
Mr. A. V. Gibberd, N.D.A., N.D.D., Dip. Agric. (Reading).
Mr. B. J. Hartley, N.D.A.
Mr. W. B. Hutchinson, N.D.A., Dip. Agric. (Harper Adams).
Mr. R. Leach, B.A. (Oxon).
Mr. R. D. Linton, B. Agric. (Belfast).
Mr. A. C. Maher, B.A., Dip. Agric. (Cantab.).
Mr. J. Robertson, B.Sc. Agric. (Aberdeen).
Mr. R. W. Stuckey M.A. (Cantab.), B.S.A. (Mc Gill).
Mr. F. R. Sanders, B.A., Dip. Agric. (Cantab.).
Mr. A. S. Thomas, B.Sc. Hort. (London).
Mr. A. E. Trotman, N.D.A., Dip. Agric. (Harper Adams).
Mr. C. A. Thorold, B.A. (Oxon.).
Mr. J. M. Ward, N.D.A. N.D.D., Dip. Agric. (Glasgow and Oxon.).
Mr. R. G. H. Wilshaw, B.Sc., B.A. (Oxon.).
Mr. J. Wright, 1st Class Hons., Botany (St. Andrews).
Mr. J. West, B.S.A. (McGill).

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The Empire Cotton Growing Corporation Students are as follows :—

Mr. C. W. L. Fishlock, B.Sc. Agric. (Reading and London).
Mr. R. H. Fraser, B.Sc. Agric. (Edinburgh).
Mr. R. L. Knight, B.Sc. Agric. (London).
Mr. C. W. Lynn, Dip. Agric. (Wye).
Mr. A. N. Prentice, B.Sc. Agric. (Edinburgh).
Mr. A. Pickles, 1st Class Hons., Zoology (Leeds).
Mr. R. Turner, B.Sc. Agric. (Edinburgh).

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The following Students are taking "Refresher" Courses :—

Mr. T. R. Hayes, M.Sc. Tech. (Manchester) Agricultural Superintendent, Gambia.
Mr. E. N. de Lestang, Inspector of Plantations, Agricultural Department, Seychelles.
Capt. J. M. Wingate, Assistant Superintendent of Agriculture, Gold Coast.

The following Students are taking Special Courses :—

Mr. C. G. Akhurst, Slater Research Scholar, A.R.C.S., B.Sc. (London).
Mr. R. D. M. Barnard (St. Vincent).
Mr. D. L. Ferguson (Grenada).
Mr. R. L. Getty, Assistant Chemist, Caroni Estate, Trinidad.
Mr. G. Des Grottes (Martinique).

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EXAMINATION RESULTS.

AT a meeting of the Academic Board held on the 1st October, the following Students were awarded the Associateship of the Imperial College of Tropical Agriculture: —

Mr. M. Afzal, B.Sc., Agric. (India).
Mr. A. K. Briant, Trip. pt. I, Dip. Ag., pt. I and II (Cantab.).
Mr. F. E. Buckley (A.R.C.S., 2nd Class).
Mr. G. Cowan Dip. Agric. (Glasgow).
Mr. H. R. Hosking, B.Sc., Hons. A.R.C.S., pure Bot. (Lond.).
Mr. E. W. Leach, B.Sc. (Reading).
Mr. A. H. Lewis, B.Sc., Hons. Chem. (Lond.).
Mr. E. B. Martyn, B.A. (Oxon).
Mr. J. H. Palmer, Trip., pt. I, Dip. Ag., pt. I (Cantab.).
Mr. N. V. Rounce, Dip. Agric. (Wye).
Mr. C. L. Skidmore, B.Sc. Agric. (London).
Mr. H. P. Smart, B.Sc. (Transvaal).
Mr. C. B. Taylor, B.Sc., 2nd Class Hons., Ag. and Bact. (Leeds).
Mr. G. N. K. Turnbull, Dip. Agric. (Glasgow).
Mr. O. J. Voelcker, Trip, pt. I, Dip. Ag., pt. I. (Cantab.).

Diplomas were awarded to Messrs. L. S. Birkett and A. C. G. Palmer, the latter securing a first class.

Pending the presentation of their dissertations a decision concerning several other students has been postponed.

SPORTS.

At a general meeting of the Imperial College Amalgamated Clubs held on 9th October, the following Students were elected officers of the several Clubs :—

Chairman of Amalgamated Club	..Capt. J. M. Wingate.
Rugby Captain ..	..Mr. J. Wright.
Association Football Captain	..Mr. F. R. Sanders.
Cricket Captain ..	..Mr. R. Leach.
Hockey Captain ..	..Mr. A. C. Maher.
Tennis Captain ..	..Mr. B. J. Hartley.

TRINIDAD SCIENCE CLUB.

MEETINGS of the Trinidad Science Club are held in the Reading Room of the Students' Dining Hall, generally on the last Thursday of each month, from October to June. Students are invited to become members of this Club ; the subscription to which is $1. A place is reserved on the Committee for one post-graduate. Further information about the Club can be got from the President, Mr. G. Evans, Principal of the College, or from the Honorary Secretary, Mr. G. Wright, Lecturer in Economics.

TREND OF THE MARKETS.

[*The notes below are based principally upon running charts of the prices of the basic grades and upon general statistical information gleaned from contemporary publications and cablegrams and are intended to be a record of movements. An attempt is made, where possible, to indicate the market outlook at the time of going to press, but no responsibility for the accuracy and subsequent truth of such observations is assumed. Unless otherwise stated the prices quoted are spot, London.*]

SUGAR.—Since the beginning of September the course of prices has been downward. Quotations for raws at various dates have been as follows: Foreign, *c.i.f.*, per cwt., 11*s.* 7½*d.* (1st Sept.) 10*s.* 10½*d.* (15th Sept.), 10*s.* 4½*d.* (29th Sept.), 10*s.* 0*d.* (6th Oct.); preferential *c.i.f.* per cwt., 15*s.* 4½*d.* (1st Sept.), 14*s.* 10*d.* (15th Sept.), 14*s.* 4½*d.* (29th Sept.), 14*s.* 0*d.* (6th Oct.). That there will be an increased crop from Cuba, in the absence of restriction, is a certainty, while with respect to Java a very important record figure is expected. No little apprehension was occasioned in sugar trade circles by the severe cyclonic disturbances in the West Indies. With the exception of Porto Rico, the damage has been mostly confined to the destruction of property and sugar factories and crops are said to have suffered comparatively little damage. Stocks of sugar in the United Kingdom in September were 3,679,000 cwt. against 5,100,000 cwt. a year ago and 6,308,000 cwt. pre-war.

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COCOA.—October 12th. The cocoa market was nothing more than a narrowly (one might almost say leisurely) fluctuating one during the last fortnight. Spasmodic indications of strength were always followed by a quantity of selling orders that would cause the market to lose its gain quite as rapidly as the gains were registered. Furthermore, the presence of the large quantities of small mid-crop Lagos and Accras prevent operators from offering any support to the spot month, as receiving delivery of them on the Exchange can only mean the resale there just so long as they do not otherwise disappear. Sales of Superior Bahia were quoted at from 11¼c. to 11½c., Accra from 11⅜c. to 11¾c., Sanchez from 10⅛c. to 10½c. and some little interest in Trinidads at around 12¼c.—(*By courtesy of the Cocoa Planters' Association, Trinidad.*)

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COTTON.—During the week ending 22nd Sept., a decline took place (20th Sept., Mid-American, 9.97*d.*) Trade buying has been a small feature in the United Kingdom, but larger in New York. The Egyptian market has also shown a sharp decline. Sakels on the spot have been rather neglected, but something has been done in uppers. The *Liverpool Circular* for 21st Sept., states that "African continues in fair demand; the quotations of West are raised 15 points, those of East generally 5 points."

COFFEE.—In the fortnight ending 17th Sept., 4,639 bags were offered for auction of which 2,622 consisted of early arrivals of Kenya and other East African descriptions and 1,585 of Colombian. The former mostly sold at fair prices (126 to 155*s.*), but London cleaned Colombian was irregular of sale, up to 152*s.* per cwt. being realised for good bold sizes, but several parcels failing to find buyers. Full prices were realised for a few Blue Mountain Jamaicas, up to 203*s.* per cwt. being paid.

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TEA.—On 19th September averages were Indian 16*d.*, Ceylon 19.96*d.*, Java 11.28*d.*, Sumatra 13.528*d.* The high price tea of Assam and Darjeeling stood at 20.11*d.* and 23.55*d.* respectively, but a year ago 24.94*d.* and 27.39*d.* were averaged. Sales of the 1927-28 season, all packages sold in London were 2,007,254 at 18.53*d.*, against a 1926-27 record of 1,927,314 at 17.54*d.* per lb. The best feature of recent trade is the increase of re-exports, especially of Indian and Java tea.

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RUBBER.—The average for the period 8th-13th Sept., was 8.75*d.* as against an average of 9.13*d.* per lb. for the season to 15th September and this indicates a weak market. Spot prices for plantation sheet during September and early October ranged round 8½*d.* per lb.

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COPRA.—Sales at the end of September include Samoa at £24 0*s.* 6*d.*, Zanzibar at £24 17*s.* 6*d.*, Mozambique at £25, Java at £25 5*s.* 6*d.*, Mauritius at £25 10*s.*, and Malabar at £26 15*s.* per ton.

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SISAL AND HARD HEMP.—Sales have included New Zealand at £32 for H.P.F., Indian at £25 for H.J.F., Kenya No. 1 (sisal) at £36 per ton Philippine Musa hemp has a wide price range, but is not in special demand.

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GROUND NUTS.—East African arachis at £21 7*s.* 6d. and Rufisque at £16 10*s.*, sell very steadily, but the trade is most interested in the new Indan crop, which for early January shipment is offered at £19 17*s.* 6*d.* and is already the subject of not a few transactions.

CITRUS FRUITS.

THE *Rhodesian Agricultural Journal* (Volume xxiv. 12., and xxv, 1.) contains an article on "Citrus Fruit Growing in Rhodesia," where the author, Mr. G. W. Marshall, Government Horticulturist discusses in detail the factors of soil, climate, aspect, shelter and varieties in the establishment of a plantation. A description of the cultivation, irrigation, manuring, liming and planting of a new plantation and its general care when in bearing is also given in full. The article which is well illustrated, is written primarily for the benefit of the Rhodesian industry but should be of interest to citrus growers in other parts of the world.